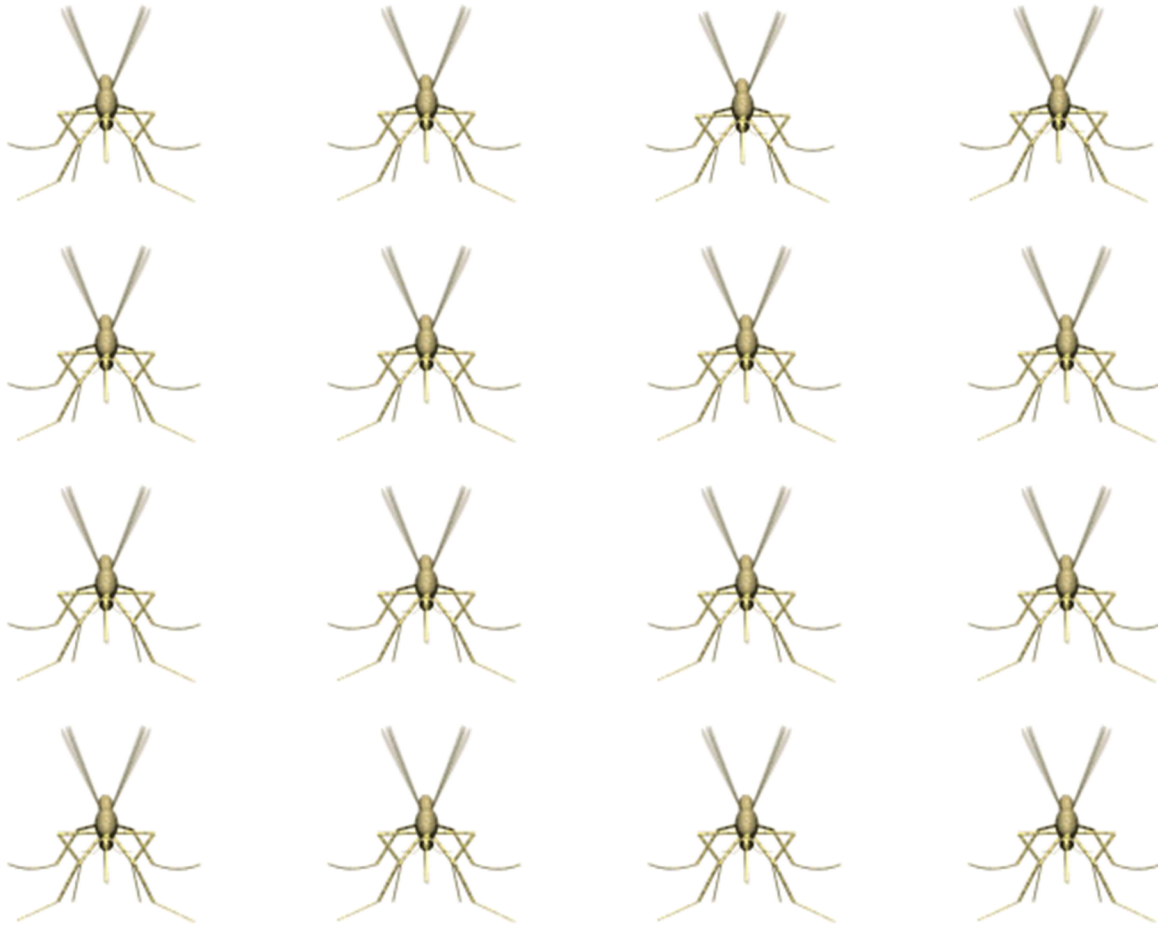


# 2015

## *North Dakota*

### *Mosquito Surveillance Program*



## **Collaborators**

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## **2015 North Dakota Mosquito Surveillance Program's Mission**

Through mosquito collection and speciation, the North Dakota Department of Health (NDDoH) monitors the risk of infection from arboviral encephalitides that are known to occur in this region. The North Dakota Mosquito Surveillance team focuses activities on *Culex tarsalis*, monitoring for increased numbers in the New Jersey mosquito trap network and viral identification using the CDC miniature light mosquito trap network. Should mosquito populations reach significant levels or arbovirus activity is detected, appropriate recommendations for mosquito population control will be issued by the NDDoH to the vector control districts.

## Table of Contents

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<b>North Dakota Mosquito Surveillance Program Background</b>	4
<b>New Jersey Mosquito Trap Network</b>	
Operator List	5
2015 Network State Map	7
Network Information	8
2015 Species Comparison Graph	8
2015 Network Mosquito Count Results	9
<b>Arbovirus Information</b>	10
<b>Mosquito Surveillance Risk Assessment Chart</b>	12
<b>Appendix A: 2015 New Jersey Mosquito Trap Data Analysis</b>	
Introduction	13
Graphs	15
<b>Appendix B: 2005-2015 Weekly New Jersey Mosquito Trap Counts Comparison</b>	
Introduction	25
Trap Count Graphs	25
<b>References</b>	32

## **North Dakota Mosquito Surveillance Program Background**

Since 1975, the North Dakota Department of Health has monitored the mosquito populations throughout the state. The Mosquito Surveillance Program traditionally has been activated following arboviral outbreaks or flooding incidents in various locations statewide.

The program was first initiated in 1975 following an outbreak of western equine encephalitis (WEE) and St. Louis encephalitis (SLE) in the United States. In 1977, the program was officially formed under the title *North Dakota Arboviral Encephalitis Surveillance Program* and housed with the Division of Environmental Sanitation and Food Protection. This program was responsible for equine and human arbovirus surveillance until 1989.

The program was reinstated under the name *North Dakota Mosquito Surveillance Program* in 1994 in response to flooding of the Red River in 1993. This program was operated by the Division of Microbiology until 1997.

In 2000, the *North Dakota Mosquito Surveillance Program* was reinstated in response to the 1999 West Nile virus (WNV) outbreak in New York. In 2002, North Dakota had its first confirmed human cases of WNV, as well as detectable virus through laboratory testing in birds, horses and mosquitoes.

The 2003 program was expanded from 50 New Jersey mosquito traps to a network of 87 traps and 18 CDC miniature light mosquito traps. These enhancements provided network coverage statewide. The 2004 program further expanded the trap network to include 94 New Jersey mosquito traps and 33 CDC miniature light mosquito traps. A video also was produced to aid in trap placement training.

The 2005 program was further expanded to 103 New Jersey mosquito traps and 39 CDC miniature light mosquito traps. The program for 2006 had 100 New Jersey traps in operation, with at least one in each county. The dry conditions during the 2006 season kept the mosquito numbers low when compared to other seasons, and it was decided to postpone any live trapping.

In 2007, due to increased *Culex tarsalis* numbers in the state, 97 New Jersey traps were used. In July, live trapping was initiated in Grand Forks, on the grounds of the laboratory, in Bismarck. Four out of 17 pools collected at the laboratory tested positive for West Nile virus. All 14 pools collected by Grand Forks and the five pools collected by Bismarck were negative. In 2008, trappers across the state maintained a New Jersey light trap network of 92 traps. Live trapping was not implemented in 2008 by the Division of Laboratory Services - Microbiology.

In 2009, 91 total New Jersey light traps were in operation. Despite the spread of West Nile virus and proof it is established in our state, funding for many programs is limited and live trapping was discontinued in 2010. The New Jersey light trap portion of the program has not been affected. The program has run essentially unchanged from 2010 to present, with varying amounts of New Jersey light traps.

*Information about West Nile virus in North Dakota is available at [www.ndhealth.gov/wnv](http://www.ndhealth.gov/wnv).*

## **New Jersey Mosquito Trap Network**

The New Jersey mosquito trap network monitors mosquito populations throughout the state. By identifying mosquito populations known to be competent encephalitis vectors, officials can determine the threat of mosquito-borne encephalitis in various regions.

*Thank you to the following New Jersey mosquito trap operators, listed below, whose dedication and commitment to the North Dakota Department of Health Mosquito Surveillance Program made the 2015 program a success!*

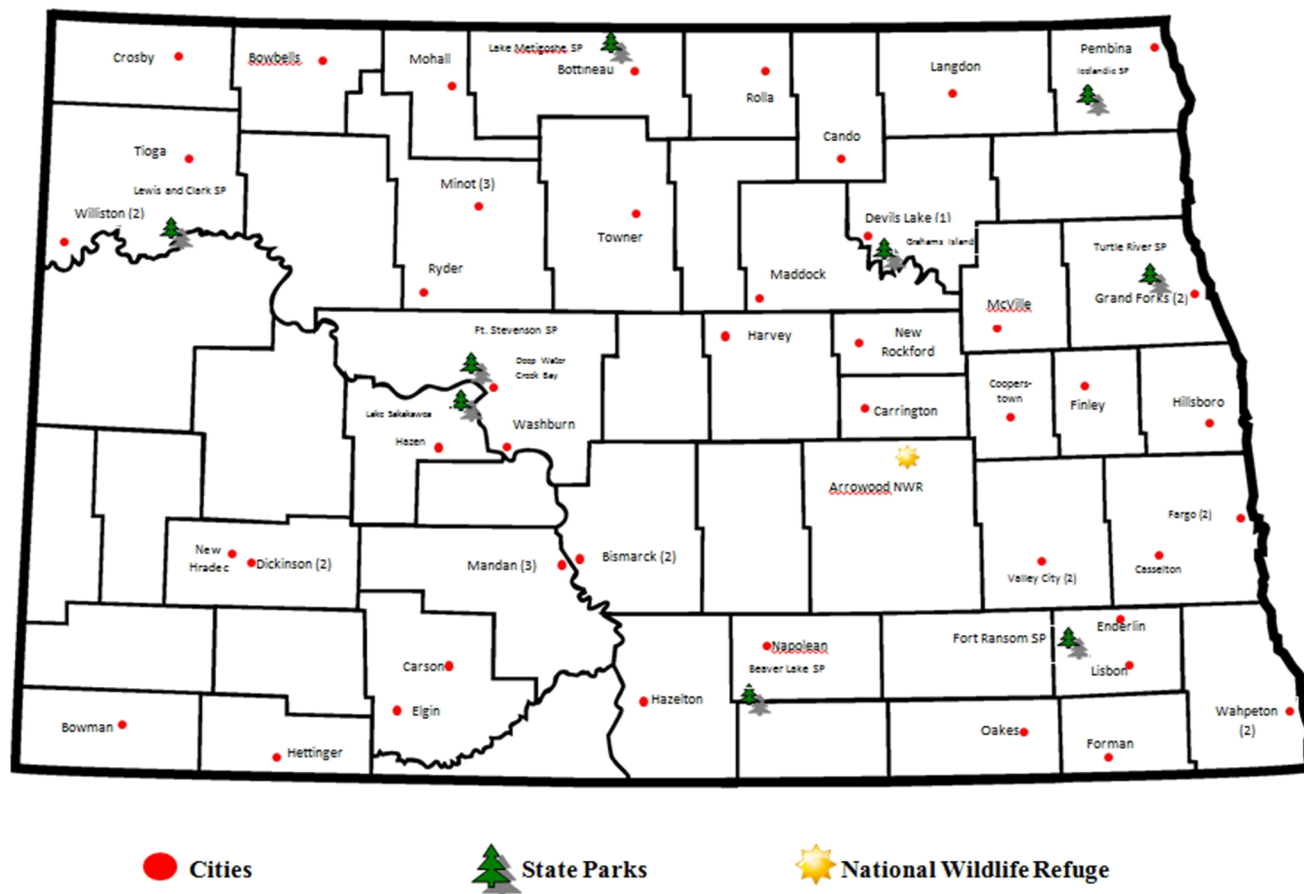
\*Indicates State Park    \*\* Indicates National Wildlife Refuge

Location	Trapper	Location	Trapper	Location	Trapper
Arrowwood**	Paulette Scherr	Elgin	Duane Schatz	Lake Metigoshe*	Larry Hagen
Beaver Lake*	James Loken	Enderlin	Rick Gillund	Lake Sakakawea*	Greg Corcoran
Bismarck	Anton Sattler & Jessica Douglas	Fargo	Ben Prather	Langdon	Rob Gilseth
Bottineau	Keith Fulsebakke	Finley	Brittany Ness	Lewis & Clark*	Ryan Gardner
Bowbells	Peter Willyard	Forman	Colleen Sundquist	Lisbon	Randy Seelig
Bowman	Andrea Bowman	Fort Ransom*	Tyler Modlin	Maddock	Pam Lee
Cando	Monte Miller	Fort Stevenson*	Chad Troutman	Mandan	Aaron Johnson
Carson	Donna VandenBurg	Grahams Island*	Henry Duray & Ryan Nelson	McVile	Ryan Johnson
Carrington	Bonnie Turner	Grand Forks	Todd Hanson	Minot	Lisa Otto & Chris Sutton
Casselton	Ben Prather	Harvey	Jay Stolz	Mohall	Tami Aberle
Cooperstown	Nancy Paintner	Hazelton	Bev Voller	Napoleon	Sheldon Gerhardt
Crosby	Dennis Lampert	Hazen	Aaron Johnson	New Hradec	Kevin Pavlish
Deep Water Creek Bay	Kerry Hartman	Hettinger	Julie Kramlich	New Rockford	George Ritzke
Devils Lake	Myron Asleson	Hillsboro	Jim Anderson	Oakes	Robert Schaefer
Dickinson	Denny Smith	Icelandic*	Char Binstock	Pembina	Ken Norby

**Mosquito Trap Network Continued:**

Location	Trapper
Rolla	Scott Hanson
Ryder	Jody Reinsch
Tioga	Kirk Odegaard
Towner	Jeffrey Smette
Turtle River*	Joseph Allen
Valley City	Jeff Differding
Wahpeton	Josh Meyer and Brenda Romerein
Washburn	Sandy and Roland Birst
Williston	Daphne Clark

## 2015 New Jersey Mosquito Trap Surveillance Sites & Regions



**The following counties are included in each region:**

Region	Counties
I	Williams, Divide, McKenzie and Mountrail
II	Ward, Bottineau, Burke, McHenry, McLean, Renville, Sheridan
III	Ramsey, Benson, Cavalier, Eddy, Pierce, Rolette, Towner
IV	Grand Forks, Griggs, Nelson, Pembina, Walsh
V	Cass, Ransom, Richland, Sargent, Steele, Traill
VI	Stutsman, Barnes, Dickey, Foster, LaMoure, Logan, McIntosh, Wells
VII	Burleigh, Emmons, Grant, Kidder, Mercer, Morton, Oliver, Grant
VIII	Stark, Adams, Billings, Bowman, Dunn, Golden Valley, Hettinger, Slope

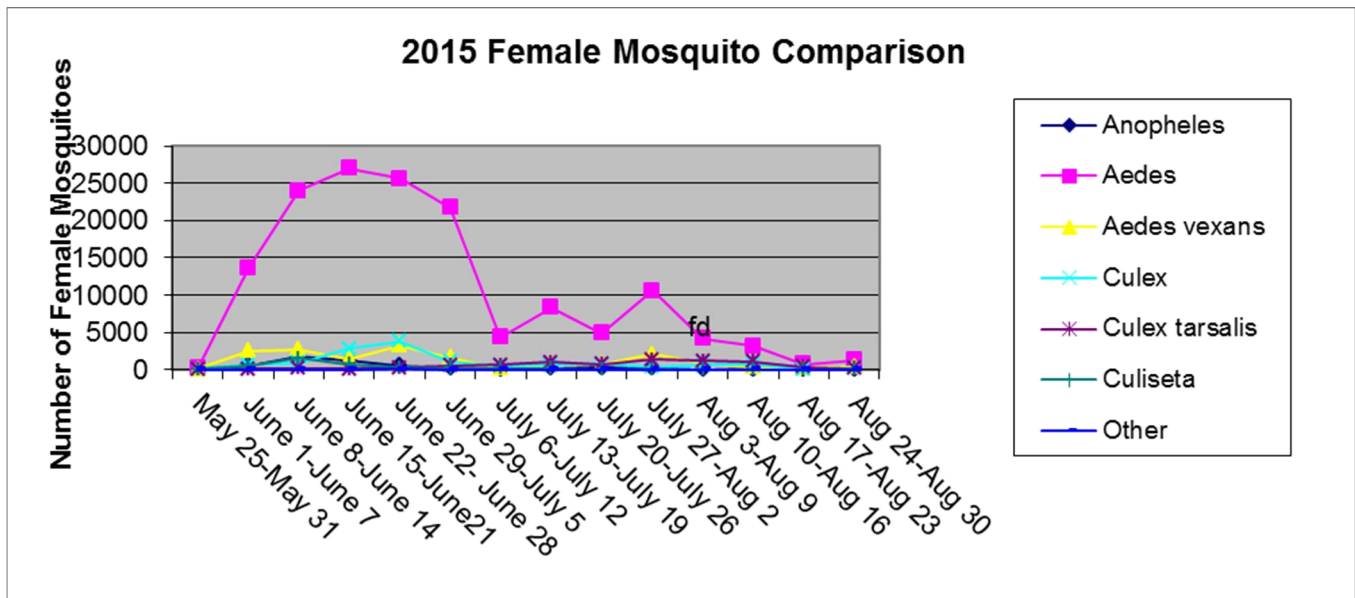
## New Jersey Mosquito Trap Network Information

In 2015, the New Jersey mosquito trap network had a total of 66 active traps across North Dakota. There were nine traps in state parks and one in a national wildlife refuge. Two New Jersey mosquito traps were located in each urban area with a population greater than 5,000.

At the beginning of the mosquito trapping season, usually Memorial Day, the New Jersey mosquito trap operator installs a trap in a suitable location. Using a programmable timer, the trap is set to operate from dusk to dawn seven nights a week. At the end of the seven-day period, the trap contents are collected and sent to the North Dakota Department of Health, Division of Laboratory Services – Microbiology (DLSM) in Bismarck for counting and speciation. This process is repeated weekly until Labor Day.

At the DLSM, mosquito surveillance personnel sort the mosquitoes by sex and genera. Since male mosquitoes do not bite, they are of little health concern. However, their numbers are monitored because male mosquitoes hatch first, and increased numbers may indicate a future female mosquito population boom. The female mosquitoes are separated into four genera: *Anopheles*, *Aedes*, *Culex* and *Culiseta*. These genera are then enumerated.

- *Anopheles* is associated with malaria and West Nile virus.
- *Aedes* is associated with illnesses such as canine heartworm, LaCrosse encephalitis (LCE), eastern equine encephalitis (EEE), western equine encephalitis (WEE), California encephalitis (CAE), and West Nile virus (WNV). Although *Aedes vexans* has been shown to be capable of laboratory transmission of WNV, its mammalian feeding preferences decrease its potential as an enzootic vector for WNV.
- *Culex* is the mosquito of greatest public health concern in North Dakota, since all species are competent vectors of Saint Louis Encephalitis (SLE), WEE and WNV. The species most commonly associated with encephalitis in North Dakota is *Culex tarsalis*, a principal arbovirus vector in rural agricultural ecosystems.
- *Culisetas* are monitored due to its association with eastern equine encephalitis.



## 2015 New Jersey Mosquito Trap Count Totals by Week - Counties

Week of	Male	Female								Total mosquitoes	% Trap sites submitted
		Anopheles	Aedes	Aedes vexans	Culex	Culex tarsalis	Culiseta	Other	Total female		
May 25-May 31	335	7	177	55	55	4	69	11	378	378	53.57%
June 1-June 7	10,632	515	13,046	2,511	651	92	534	0	17,349	27,981	71.42%
June 8-June 14	25,528	1,327	20,843	2,605	913	222	1,356	4	27,270	527,798	82.14%
June 15-June 21	30,235	1,112	24,417	1,400	2,736	107	640	14	30,426	60,661	85.71%
June 22-June 28	8,142	529	22,954	3,123	3,651	222	266	49	30,794	38,936	94.64%
June 29-July 5	3,480	140	20,334	1,636	1,013	509	161	0	23,793	27,273	89.28%
July 6-July 12	1,962	85	4,094	223	497	608	139	6	5,652	7,614	85.71%
July 13-July 19	2,213	212	8,128	740	622	832	202	4	10,740	12,953	91.07%
July 20-July 26	2,403	264	4,118	698	638	743	36	3	6,500	8,903	87.50%
July 27-Aug 2	3,567	180	8,590	1,708	344	1,306	103	13	12,244	15,811	92.85%
Aug 3-Aug 9	2,952	35	3,651	719	580	1,150	3	4	6,478	9,768	91.07%
Aug 10-Aug 16	1,625	41	2,768	307	601	965	14	5	4,235	5,860	87.50%
Aug 17-Aug 23	363	3	702	294	105	347	25	11	1,436	1,799	83.92%
Aug 24-Aug 30	316	0	1,258	370	195	153	99	1	2,044	2,360	62.50%
<b>2015 Totals</b>	<b>93,753</b>	<b>4,450</b>	<b>135,080</b>	<b>16,389</b>	<b>12,601</b>	<b>7,260</b>	<b>3,647</b>	<b>125</b>	<b>179,339</b>	<b>748,095</b>	

## 2015 New Jersey Mosquito Trap Count Totals by Week - State Parks

Week of	Male	Female								Total mosquitoes	% Trap sites submitted
		Anopheles	Aedes	Aedes vexans	Culex	Culex tarsalis	Culiseta	Other	Total female		
May 25-May 31	5	0	19	0	9	0	3	0	31	36	77.78%
June 1-June 7	210	11	587	49	12	1	21	0	681	891	89.89%
June 8-June 14	3,214	365	3,054	58	0	0	164	0	3,641	6,855	55.56%
June 15-June 21	296	44	2,532	81	60	2	63	1	2,783	3,079	77.78%
June 22-June 28	396	3	2,671	99	136	36	4	58	3,007	3,403	77.78%
June 29-July 5	277	11	1,350	3	92	28	25	0	1,509	1,786	77.78%
July 6-July 12	68	0	243	0	42	58	2	0	345	413	77.78%
July 13-July 19	28	3	96	5	11	149	2	0	266	294	66.67%
July 20-July 26	182	10	695	25	128	24	0	0	882	1,064	66.67%
July 27-Aug 2	278	10	1,936	138	7	38	17	0	2,146	2,424	89.89%
Aug 3-Aug 9	224	4	459	56	83	56	0	0	658	882	77.78%
Aug 10-Aug 16	128	8	404	56	51	107	0	0	626	754	89.89%
Aug 17-Aug 23	10	0	14	4	19	59	1	0	97	107	77.78%
Aug 24-Aug 30	0	0	27	9	11	0	0	0	47	47	44.40%
<b>2015 Totals</b>	<b>5,316</b>	<b>469</b>	<b>14,087</b>	<b>583</b>	<b>661</b>	<b>558</b>	<b>302</b>	<b>59</b>	<b>16,719</b>	<b>22,035</b>	

2015 New Jersey Mosquito Trap Count Totals by Week - National Wildlife Refuges											
Week of	Male	Female									% Trap sites submitted
		Anopheles	Aedes	Aedes vexans	Culex	Culex tarsalis	Culiseta	Other	Total female	Total mosquitoes	
May 25-May 31	0	0	0	0	0	0	0	0	0	0	100.00%
June 1-June 7	17	0	24	0	0	1	0	0	25	42	100.00%
June 8-June 14	27	5	132	24	0	0	3	0	164	191	100.00%
June 15-June 21	0	0	0	0	0	0	0	0	0	0	100.00%
June 22- June 28	1	0	23	0	1	0	2	0	26	27	100.00%
June 29-July 5	14	0	97	0	11	4	0	0	112	126	100.00%
July 6-July 12	8	3	33	0	6	3	0	0	45	53	100.00%
July 13-July 19	4	0	65	1	20	3	0	0	89	93	100.00%
July 20-July 26	45	5	50	20	52	0	2	1	130	175	100.00%
July 27-Aug 2	102	0	99	212	12	6	6	0	335	437	100.00%
Aug 3-Aug 9	39	0	19	3	9	1	0	0	32	71	100.00%
Aug 10-Aug 16	1	0	2	0	2	1	0	0	5	6	100.00%
Aug 17-Aug 23	0	0	0	0	0	0	0	0	0	0	100.00%
Aug 24-Aug 30	0	0	0	0	0	0	0	0	0	0	0.00%
<b>2015 Totals</b>	<b>258</b>	<b>13</b>	<b>544</b>	<b>260</b>	<b>113</b>	<b>19</b>	<b>13</b>	<b>1</b>	<b>963</b>	<b>1,221</b>	

### Arbovirus Information

More than 2,500 different species of mosquitoes are found worldwide, with about 200 species in the United States and at least 34 of these in North Dakota. The most common vector in the spread of arboviruses is the mosquito; however, not all mosquitoes are vectors in the transmission of arboviruses.

Male mosquitoes feed almost exclusively on nectar and therefore do not bite. Female mosquitoes lay eggs that require a blood meal and bite animals, warm- or cold-blooded, and birds. Stimuli that influence biting include a combination of carbon dioxide, temperature, moisture, smell, color and movement. Humans are seldom the first or second choice for a blood meal. Horses, cattle, smaller mammals and birds are preferred. Although acquiring a blood meal is essential for female egg production, both male and female mosquitoes are mainly nectar feeders.

Mosquito-borne diseases cause more than one million human deaths every year. Some of these diseases include protozoan infections such as malaria; filarial pathogens such as canine heartworm; and viruses that cause dengue, yellow fever and encephalitis.

Arthropod-borne viruses (arboviruses) are the most diverse and serious diseases transmitted to susceptible vertebrate hosts by mosquitoes. All arboviral encephalitides are zoonotic involving a nonhuman primary vertebrate and a primary arthropod vector. Humans and domestic animals can develop clinical illness but usually are “dead-end” hosts because they do not contribute to the transmission cycle.

**West Nile virus (WNV)** is the most recently emerged arbovirus in North America. West Nile virus is named after the West Nile region of Uganda, where it was first discovered in 1937. The *Culex* species of mosquitoes are the primary vectors, particularly *Culex tarsalis*. Common in many parts of the world, WNV had not been seen in the United States until late summer 1999, when it made its debut in New York. WNV traveled westward across the continent the following year, with the first human case in North Dakota being reported in 2002. West Nile fever can be characterized by fever, headache and rash to more serious symptoms. Although only a small percentage of people infected with WNV display symptoms,

WNV can cause encephalitis (an inflammation of the brain) and meningitis (inflammation of the brain and spinal cord) in humans and animals, and even death in some cases.

**Western equine encephalitis (WEE)** is mostly found in states west of the Mississippi River. The primary vector is *Culex tarsalis*. Birds are the most important host. Since 1964, there have been fewer than 1,000 cases reported. Human cases have historically been reported in North Dakota; however the last documented case in our state was in 1991. Human mortality rates are about 5 percent, with horse mortality rates considerably higher.

**Eastern equine encephalitis (EEE)** is spread to horses and humans by infected mosquitoes. Annually, there are a small number of cases nationwide, although no cases have historically been reported in North Dakota. EEE is the most serious of the arboviruses that can affect the central nervous system (CNS), resulting in severe complications and even death. Symptoms may range from none at all, to flu-like, to more serious infections with sudden fever and severe headache, followed by seizures and coma. About half of infected patients die, and of those who survive, many suffer permanent CNS damage.

**St. Louis encephalitis (SLE)** is transmitted from birds to mammals by an infected mosquito. SLE was discovered in 1933 in St. Louis, Mo. Since then, SLE has been reported in 46 states. Most infections of SLE do not result in illness, with mild cases exhibiting aseptic meningitis or fever. The elderly and very young children are more susceptible, with fatality rates from 2 to 20 percent, and neurologic dysfunction occurring in about 1 percent of survivors. Nineteen human cases have been reported in North Dakota from 1964 to 2010.

**The California serogroup** is a group of related viruses that include California encephalitis, La Crosse encephalitis, and Jamestown Canyon virus. Each year, about 75 cases are reported in the United States, with the majority of illnesses resulting from La Crosse encephalitis. The California serogroup viruses primarily affect male children younger than 16. Infections are mild, with a mortality rate of about four deaths per 1,000 infections.

**North Dakota Mosquito Surveillance  
Risk Assessment Chart  
for Arbovirus Activity**

<b>Risk Category</b>	<b>Probability of Human Outbreak</b>	<b>Definition of Conditions</b>	<b>Recommended Response by Mosquito Surveillance Team and North Dakota Vector Control Personnel</b>
1a	Remote	Mid-season; first week of July; no observed epizootic activity; low population counts of vector species from New Jersey trap network	Begin preliminary, low-intensity CDC live-trapping network and testing in all areas of the state; test for targeted virus presence
1b		Late-season; third week of July through September; no observed epizootic activity; high population counts from New Jersey trap network	Deploy mid-intensity CDC live-trapping network and viral testing in areas with high population counts of targeted vector species; continue low-intensity trapping and testing in other areas
2	Low	Sporadic epizootic activity in birds or mosquitoes	Deploy high-intensity CDC live-trapping network and viral testing in epizootic areas, and consider preliminary control measures such as source reduction and larval control; continue surveillance in other areas
3	Moderate	Initial confirmation of virus in horse or human; moderate activity in birds or mosquitoes	Continue as in Category 2; consider adult mosquito control as indicated by surveillance activity
4	High	Measures suggesting high risk of human infection (for example, high dead bird densities, high mosquito infection rates, multiple positive mosquito species, horse or mammal cases indicating escalating epizootic transmission, or a human case)	Response as in Category 3; initiate adult mosquito control program in areas of potential human risk
5	Outbreak in progress	Multiple confirmed human cases; conditions as listed in Category 4	Implement emergency adult mosquito control program; if widespread, consider aerial spraying

## Appendix A

### New Jersey Mosquito Trap Data Analysis

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The mosquito's life cycle has four separate and distinct stages: egg, larva, pupa and adult. A female mosquito breeds in the presence of water and lays fertile eggs after obtaining a blood meal. The location in which a female mosquito deposits her eggs in the environment depends upon larval habitat preference. The 43 mosquito species indigenous to North Dakota can be grouped into four that reflect their larval habitat preference; permanent pool, the transient water, the floodwater, and the artificial container and tree-hole.

Mosquitoes within the **permanent pool group**, *Anopheles* and *Culex* species, lay eggs either singly or side by side on the water surface of permanent ponds and lakes. Permanent pool mosquitoes can develop continuously in warm water and hatch daily into adults. **Transient water mosquitoes**, such as *Culex tarsalis*, prefer to lay their eggs in pools of a temporary nature. Common habitats of the transient water group are roadside ditches, canals, ground pools and irrigated lands. Transient water mosquito eggs in ditches and small depressions must wait until rainfall to begin the hatching process. **Floodwater mosquitoes**, the *Aedes* species, lay eggs singly on damp soil or along vegetated shorelines; the eggs remain dormant until these areas are flooded. Once flooded, the eggs hatch if conditions are favorable. Large numbers of larvae emerge, and adults can appear as early as six days after flooding. A major rainstorm, a series of showers, or irrigation sufficient enough to produce standing water promotes hatching in the floodwater species of mosquitoes. The **artificial container and tree-hole group of mosquitoes** place their eggs inside the wall of a container or depression inside a tree, at or above the water line, and the eggs hatch when the water levels rise. A heavy rain resulting in standing water in old tires, tin cans and flowerpots will begin the hatching process for artificial container mosquitoes.

Once hatched, larvae of all species emerge and live in water. After four stages, or instars, the larva molts into a pupa. The pupa stage is a resting, non-feeding stage where the pupa is encased until the adult matures and emerges from the skin after one-and-a-half to four days. Adult male mosquitoes hatch first and live from six to seven days. Female mosquitoes can live for about two weeks, but have been found to survive for up to five months with ample food. Peak adult mosquito populations usually appear within two weeks after a number of eggs hatch.

Along with increased rainfall, warmer water temperatures speed up hatching and larval development. If outdoor temperatures are 50 degrees or higher, productive breeding sites readily produce mosquito larvae. With increasing water temperatures, large mosquito populations can emerge within one week. Research in laboratory settings has shown that if the water temperature exceeds 100 degrees, it takes only three to four days for larval metamorphosis; if the temperature is 90 degrees, it takes five days; and a lower water temperature of 70 degrees decreases rate of growth to 10 days. Floodwater species of *Aedes* larvae generally metamorphose within five to seven days after hatching. The species *Culex tarsalis* completes its life cycle in 14 days at 70 degrees and in only 10 days at 80 degrees. On the other hand, some species have naturally adapted to go through their entire life cycle in as little as four days or as long as one month.

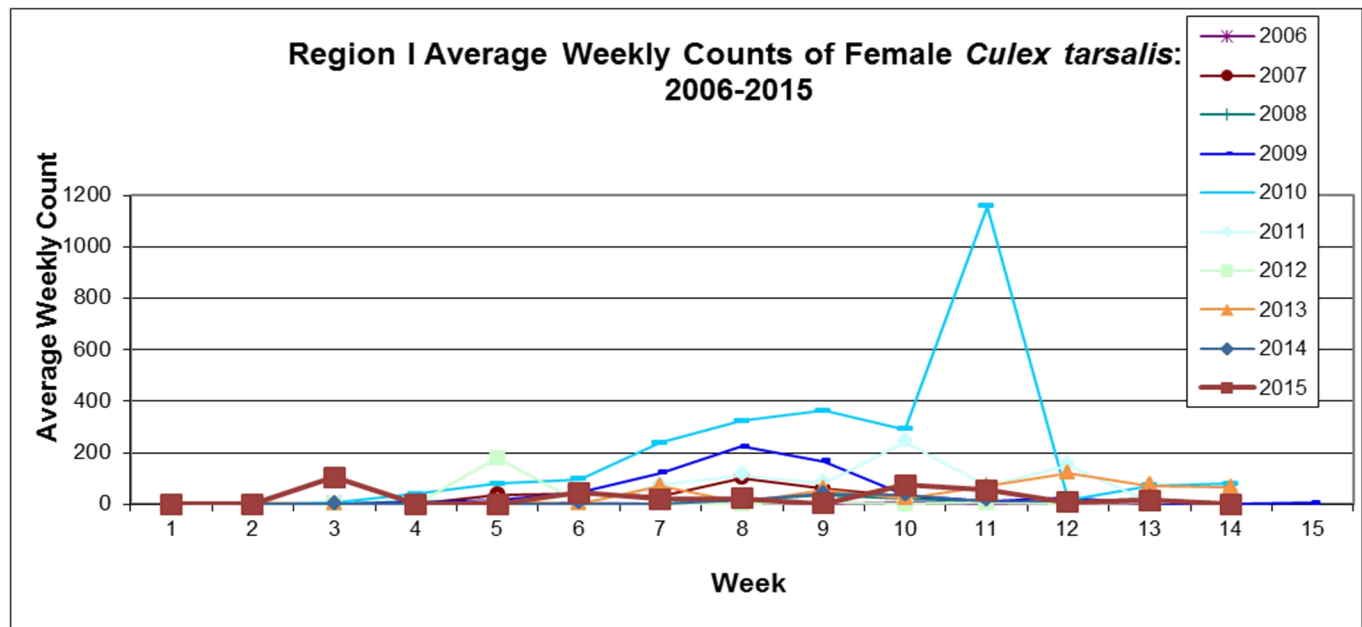
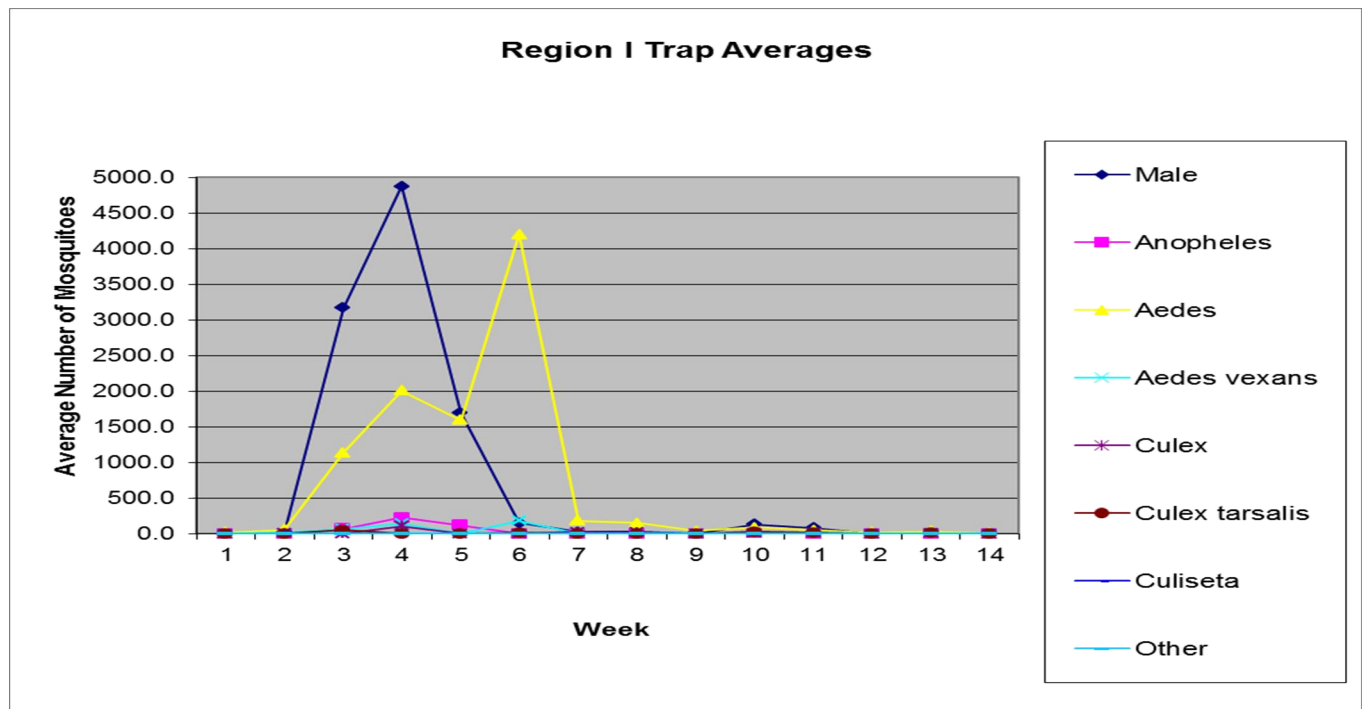
When a mosquito becomes an adult, the weather elements affect its peak activity. Most mosquitoes are active from dusk until dawn when wind speeds are less than eight miles per hour, the air temperature is between 65 and 80 degrees, and the weather is moderate.

Heavy rains, gusting winds, and cool or high daytime temperatures all limit a mosquito's feeding activity. At temperatures lower than 50 degrees, mosquitoes become sluggish, reducing their host-seeking behavior. At higher temperatures, usually during daytime hours, adult mosquitoes seek cover in vegetated or humid areas with shade.

# Region I

## North Dakota Mosquito Surveillance

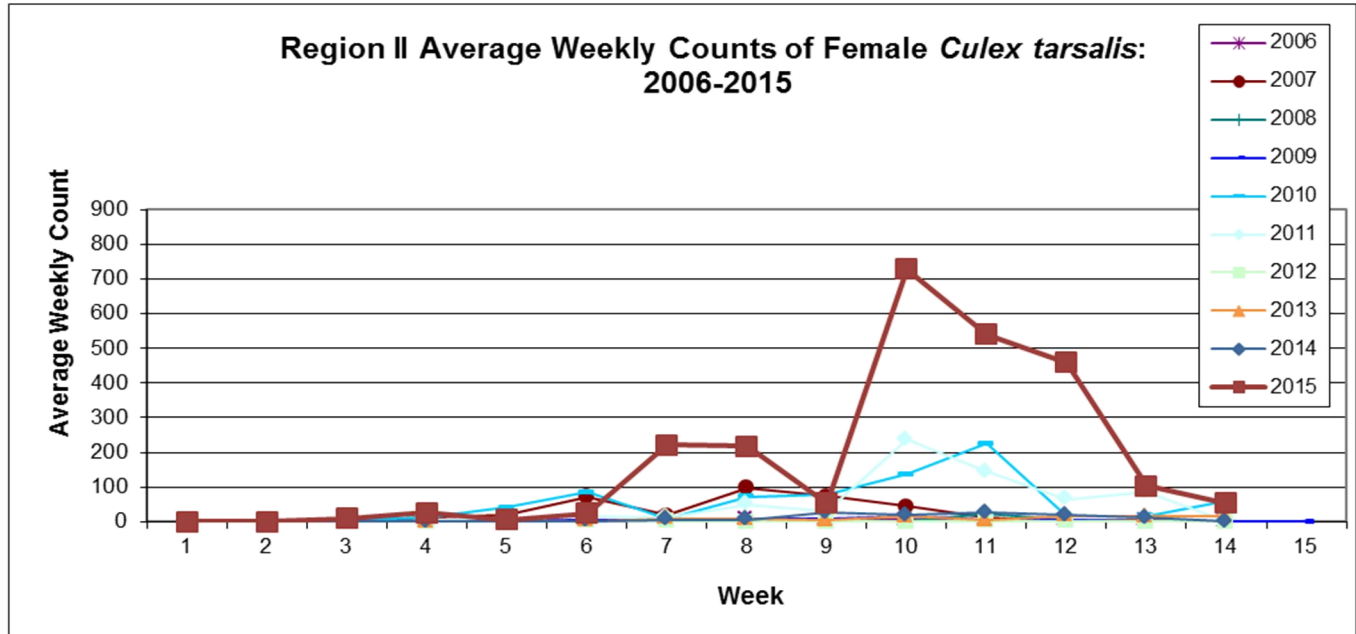
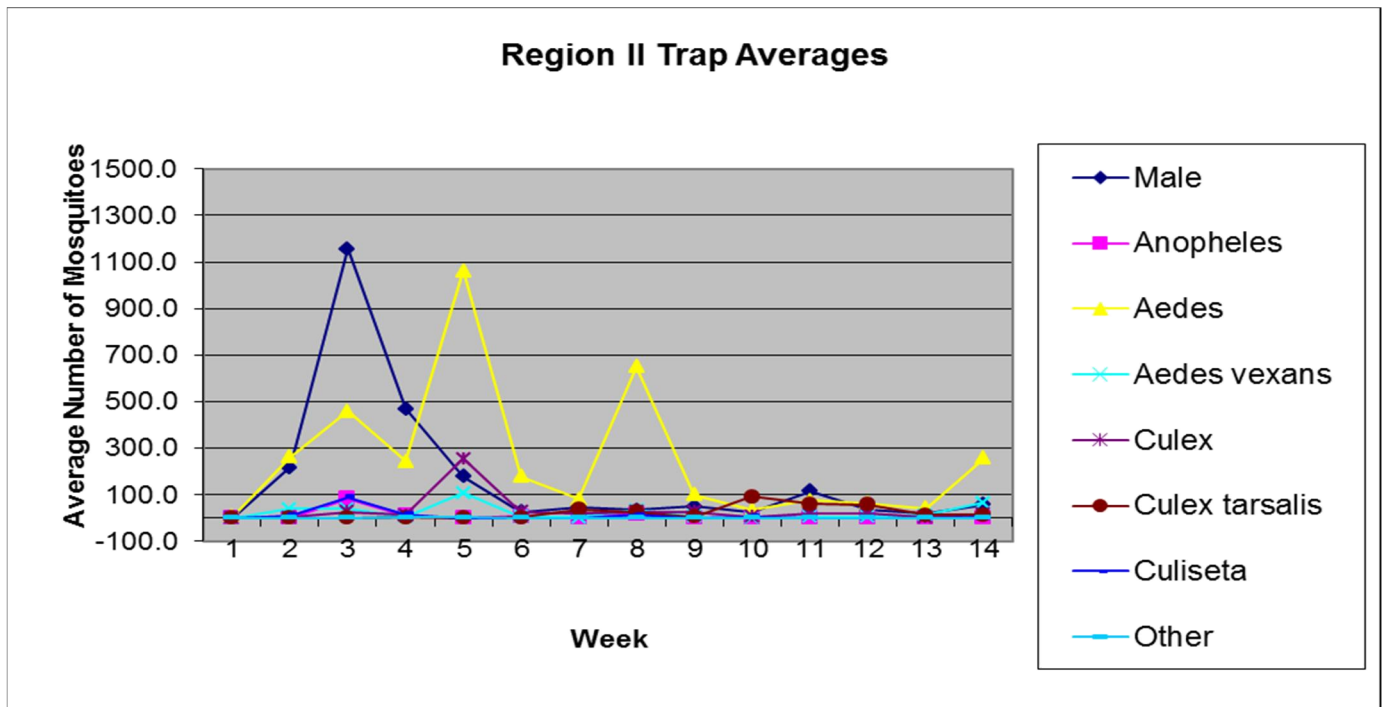
### New Jersey Mosquito Trap Data Analysis



# Region II

## North Dakota Mosquito Surveillance

### New Jersey Mosquito Trap Data Analysis

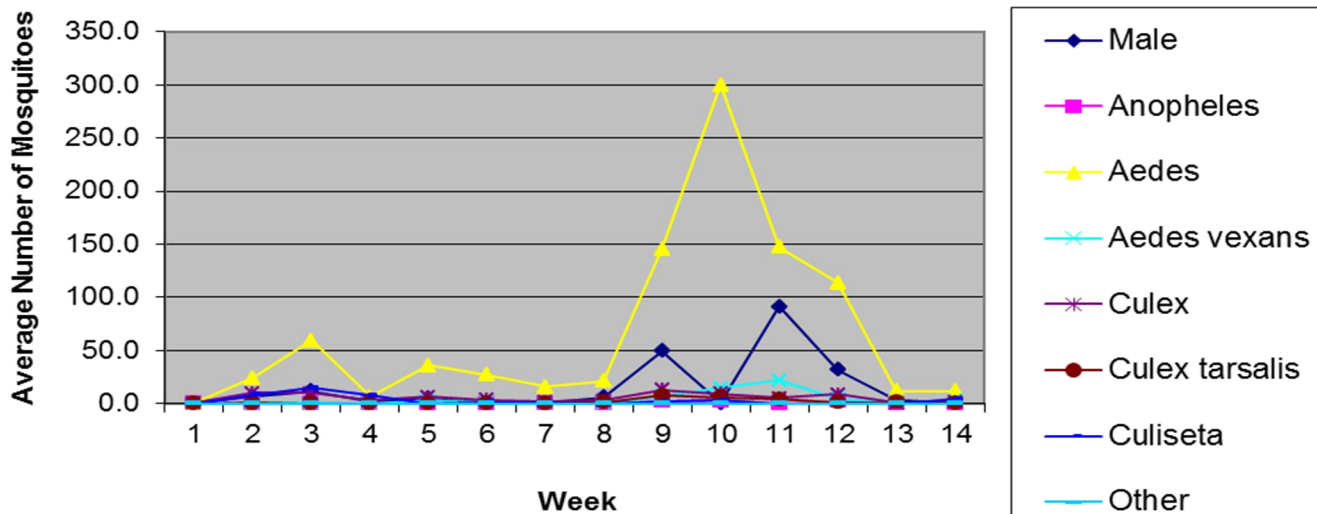


# Region III

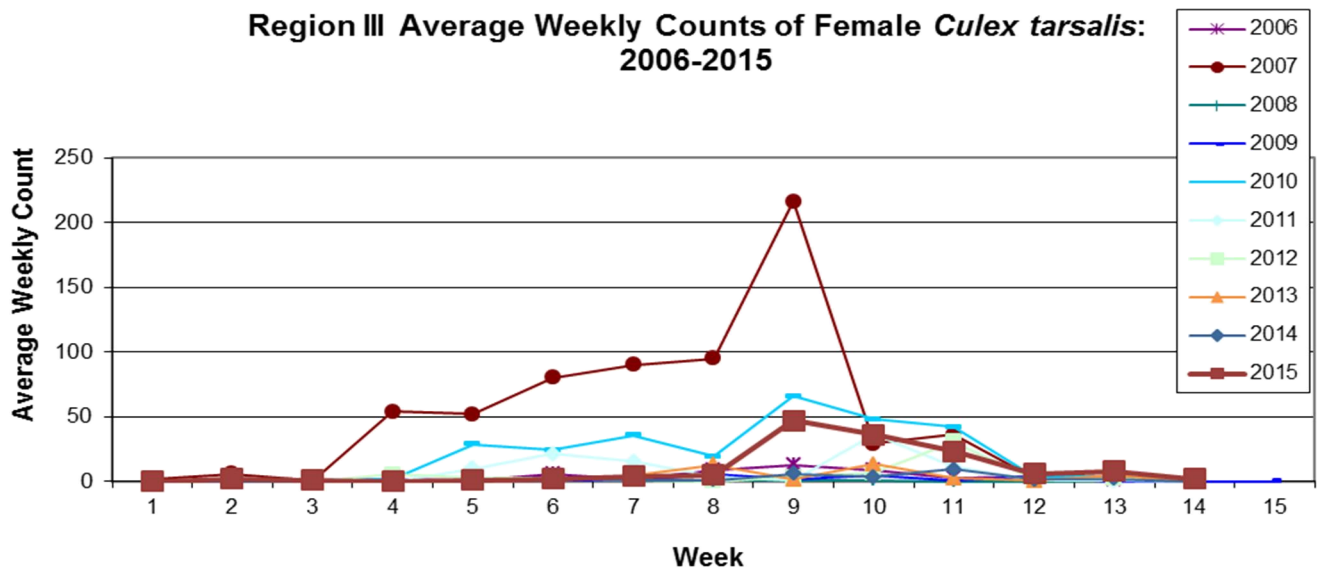
## North Dakota Mosquito Surveillance

### New Jersey Mosquito Trap Data Analysis

Region III Trap Averages



Region III Average Weekly Counts of Female *Culex tarsalis*: 2006-2015

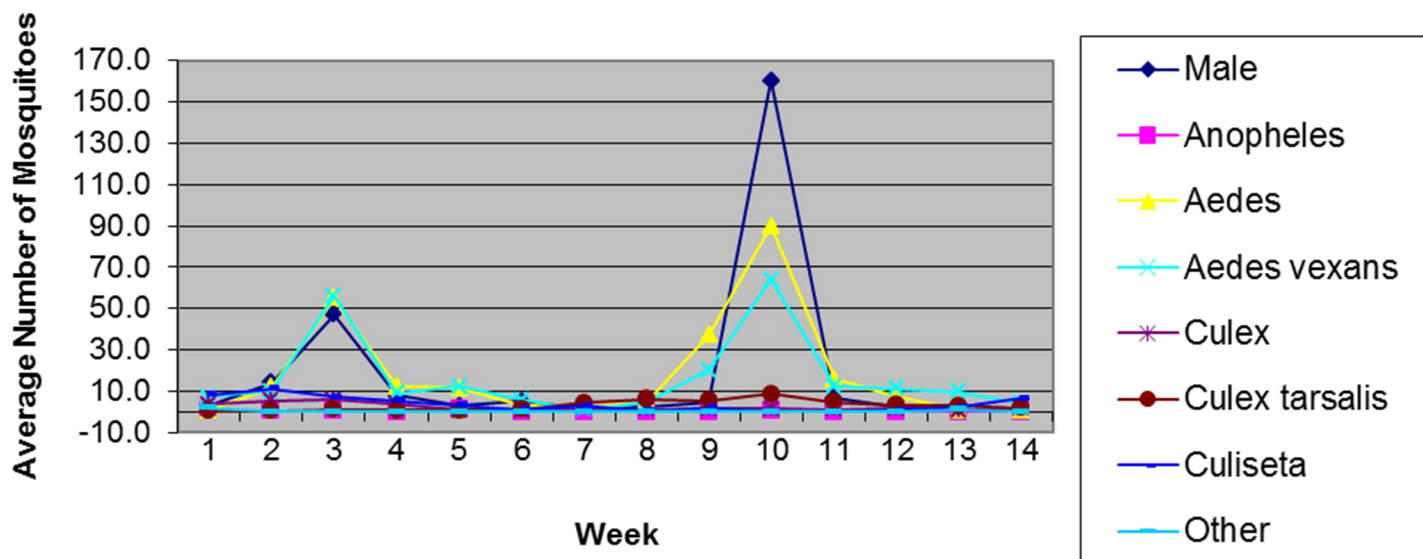


# Region IV

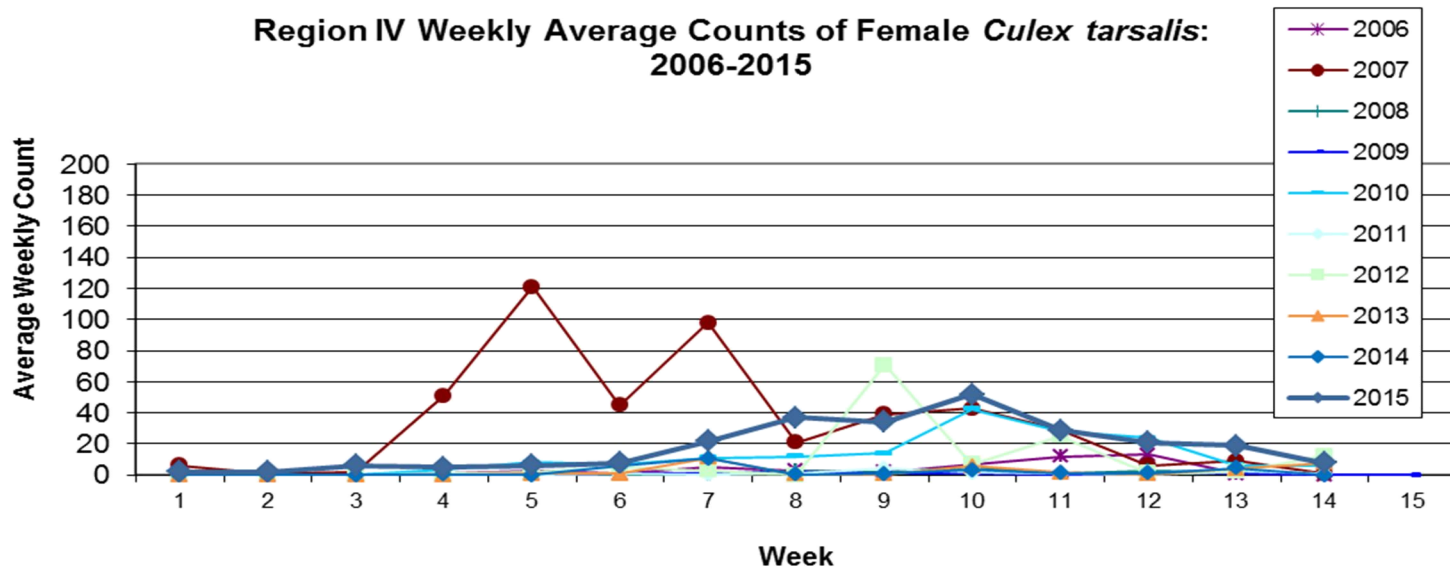
## North Dakota Mosquito Surveillance

### New Jersey Mosquito Trap Analysis

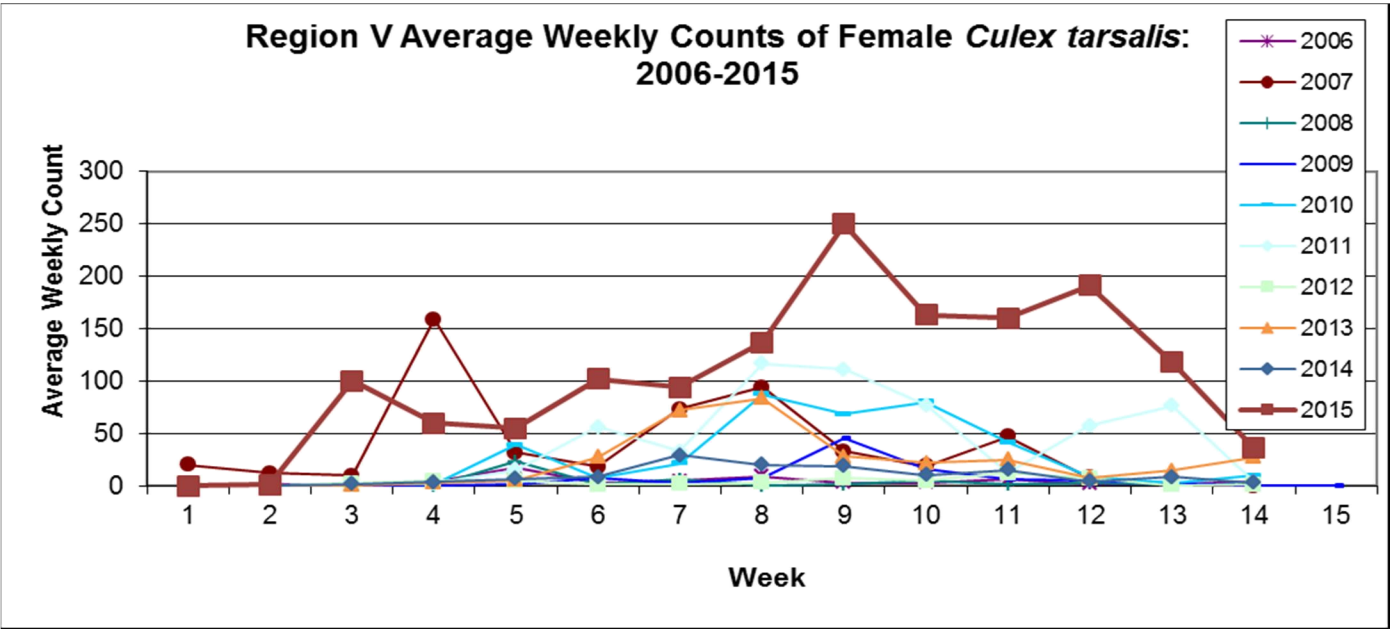
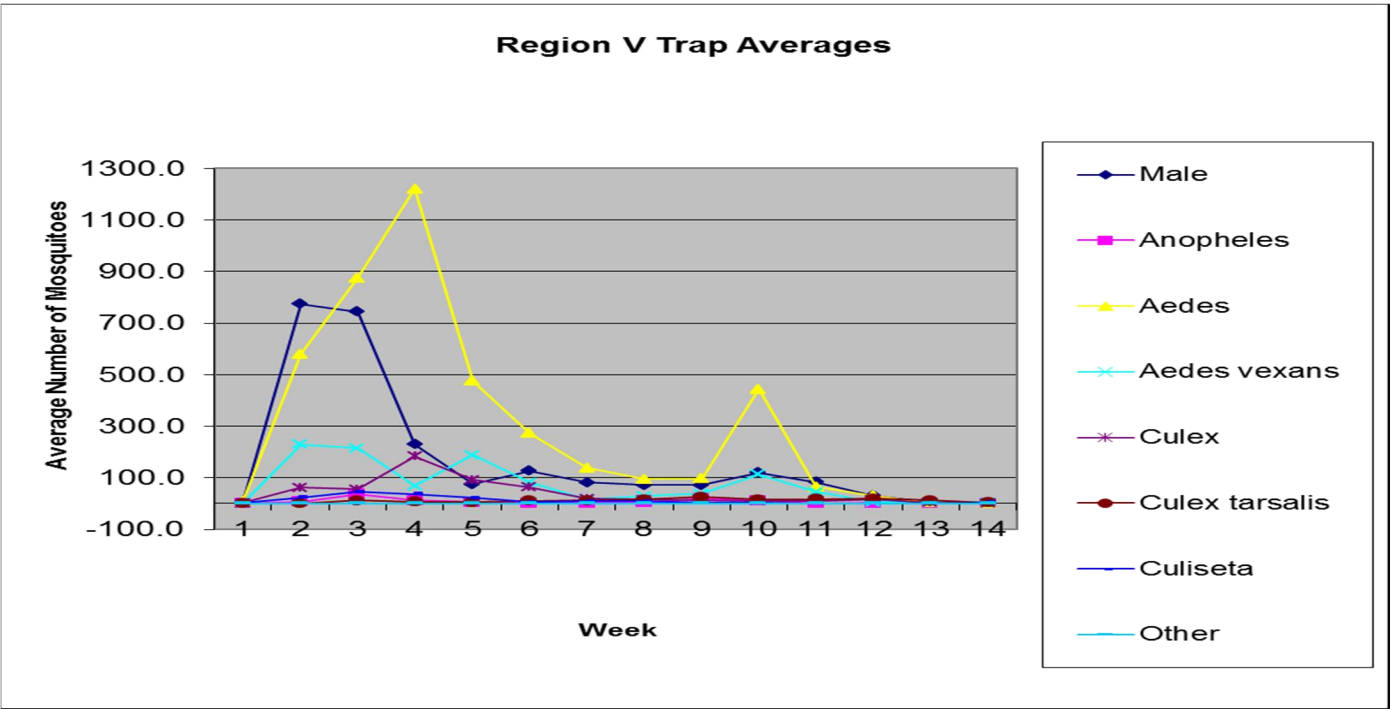
Region IV Trap Averages



Region IV Weekly Average Counts of Female *Culex tarsalis*: 2006-2015



# Region V North Dakota Mosquito Surveillance New Jersey Mosquito Trap Data Analysis

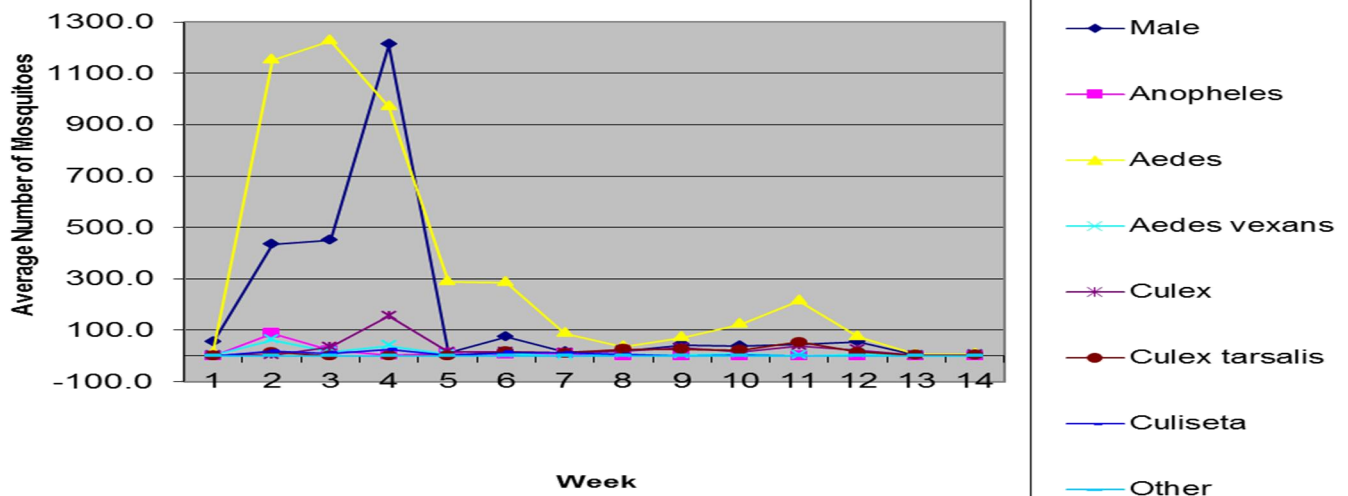


# Region VI

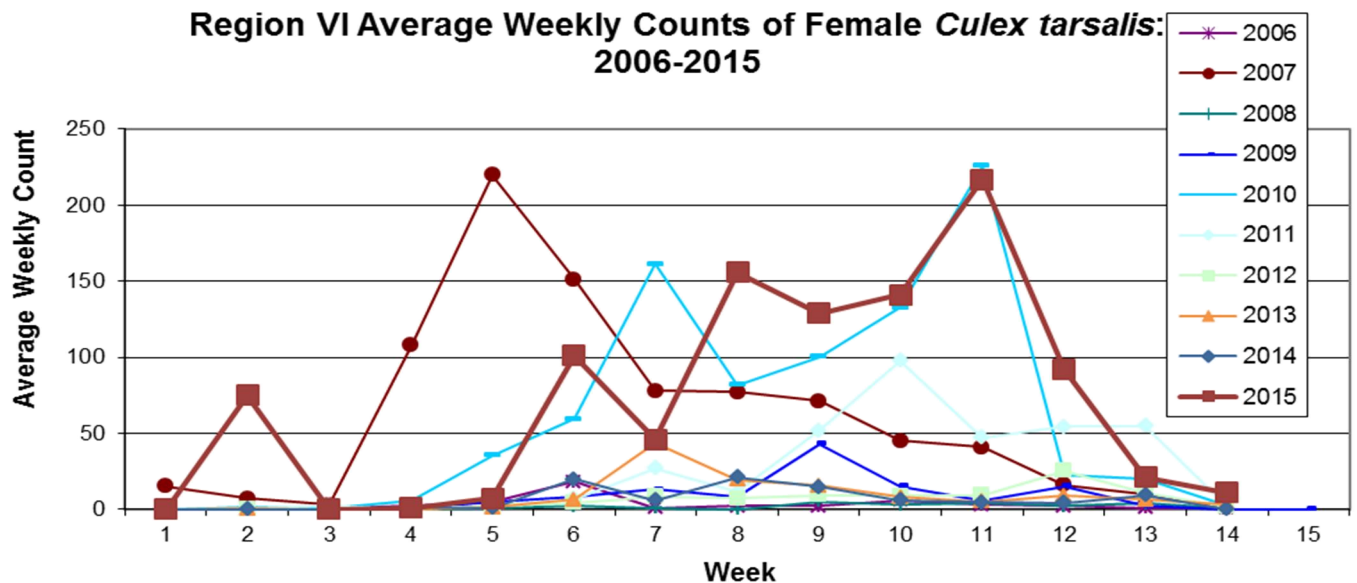
## North Dakota Mosquito Surveillance

### New Jersey Mosquito Trap Data Analysis

Region VI Trap Averages



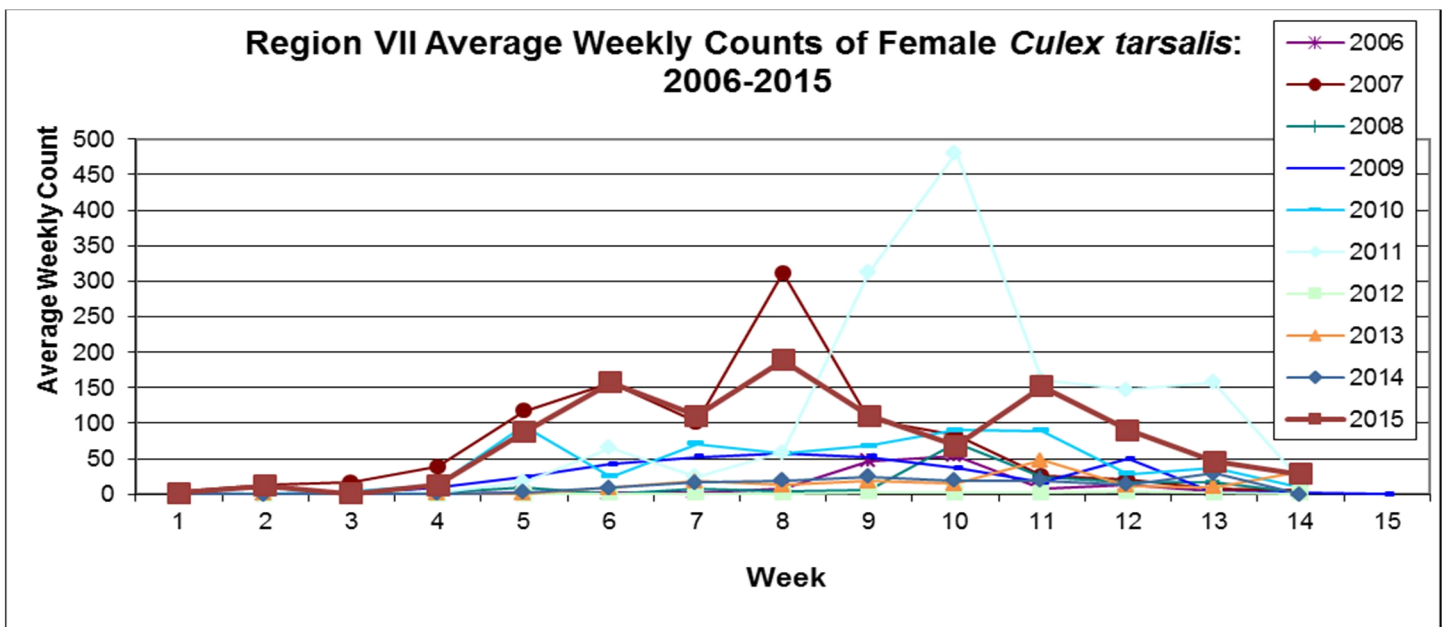
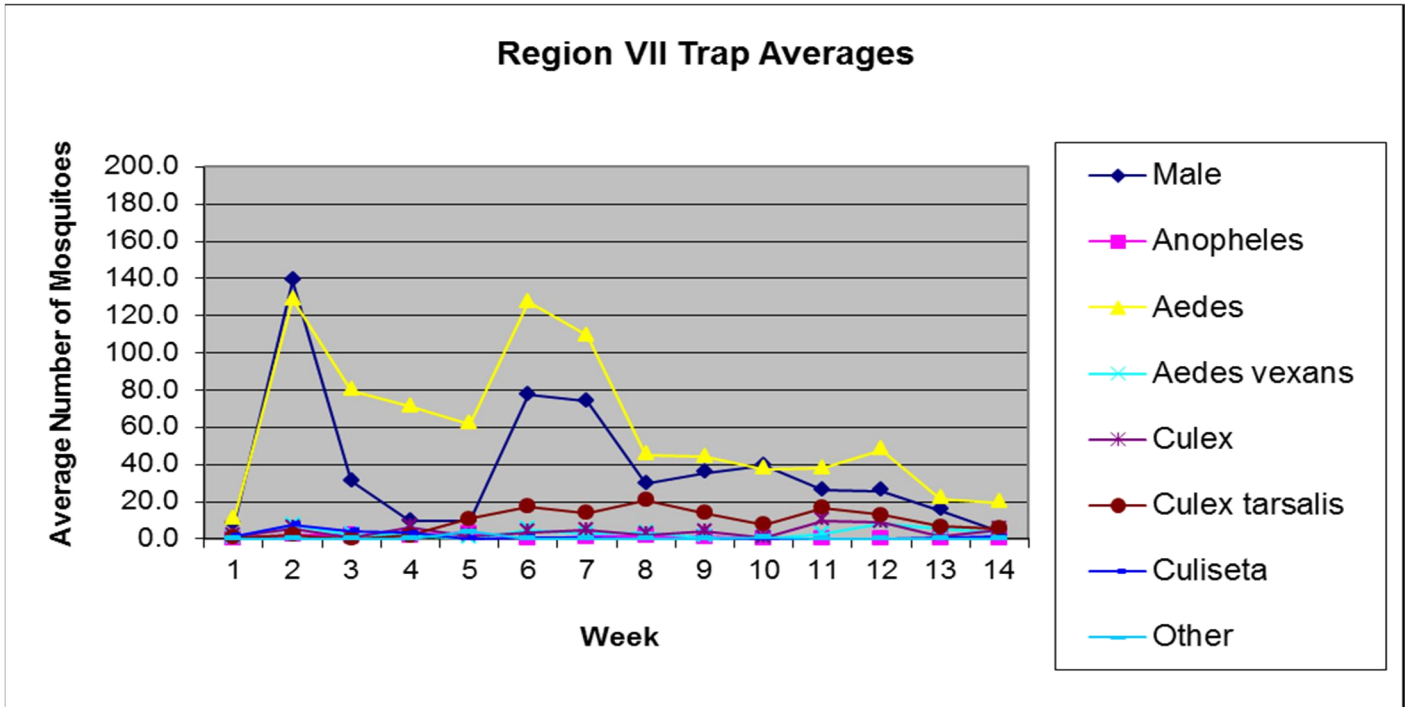
Region VI Average Weekly Counts of Female *Culex tarsalis*: 2006-2015



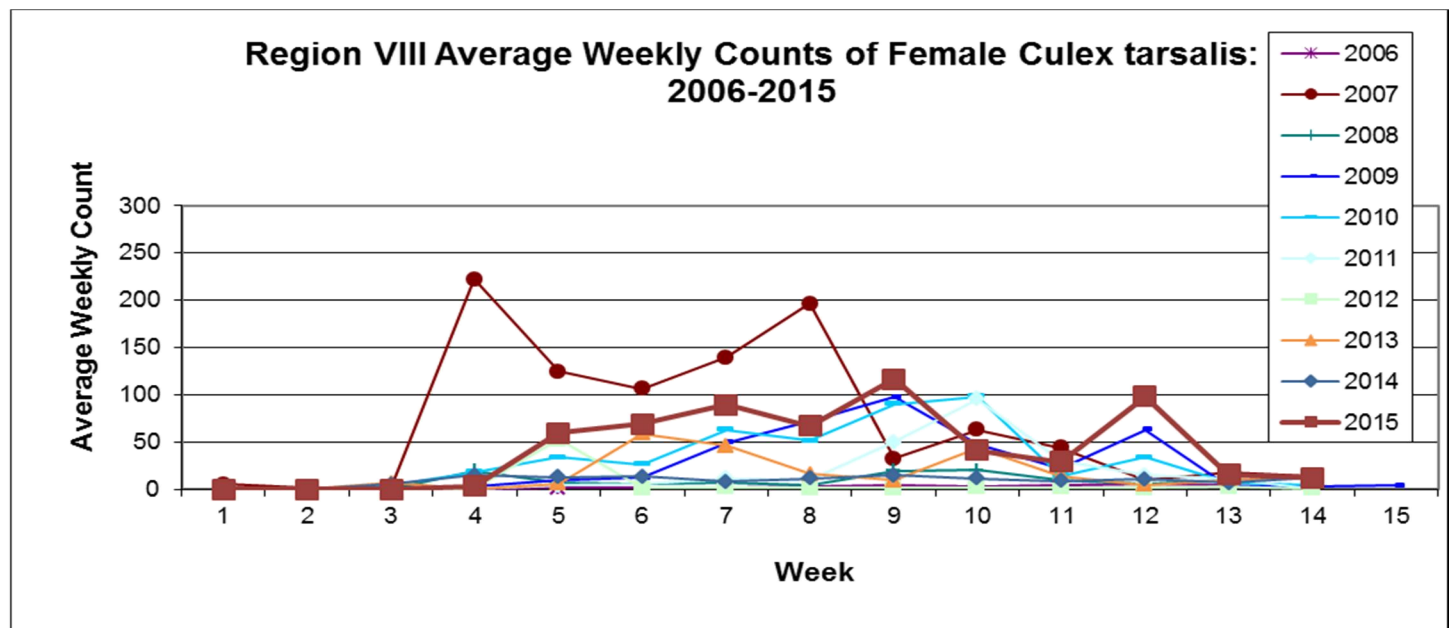
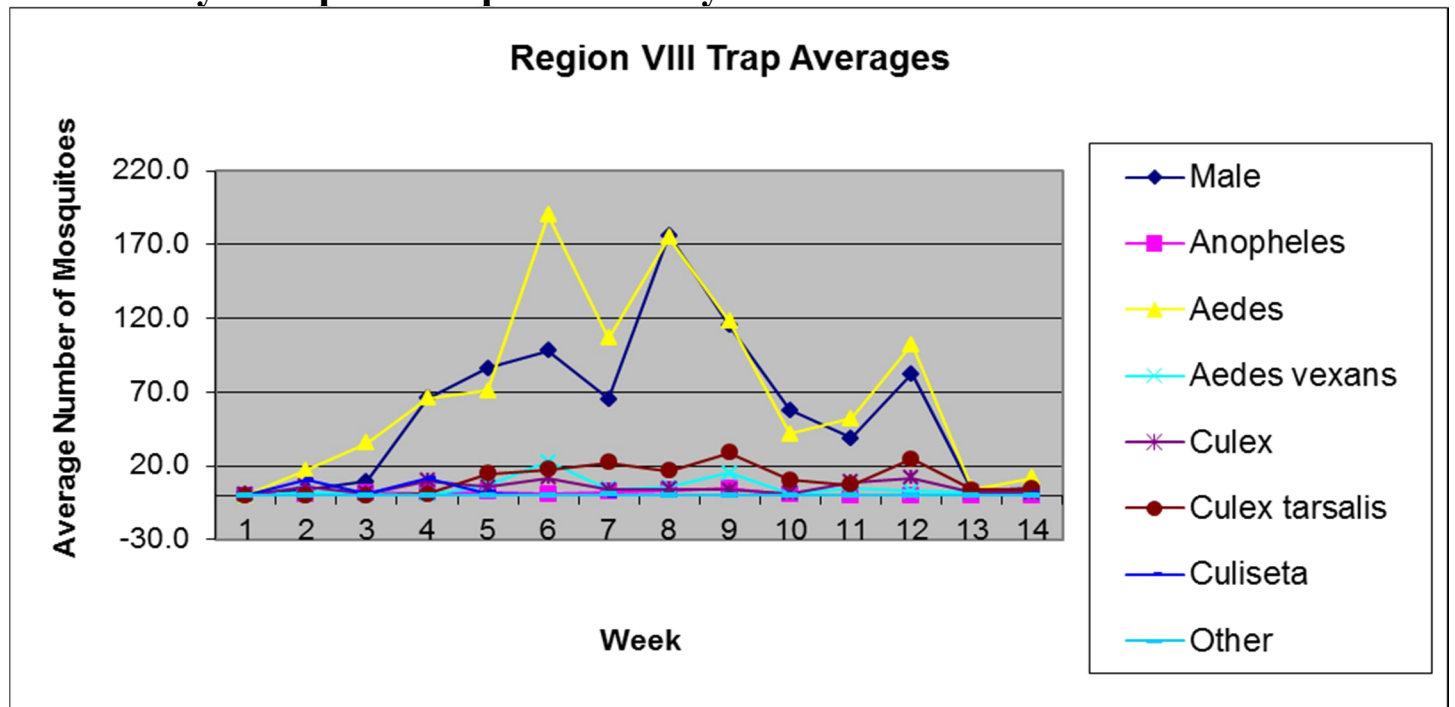
# Region VII

## North Dakota Mosquito Surveillance

### New Jersey Mosquito Trap Data Analysis



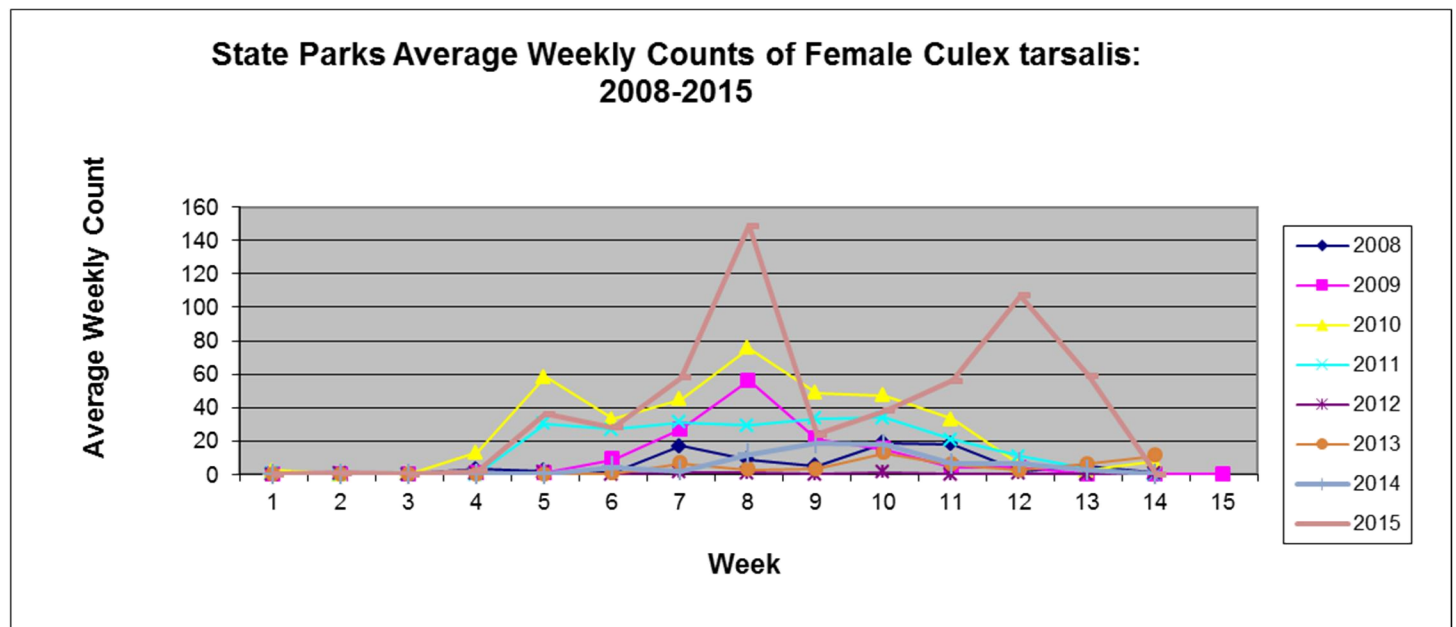
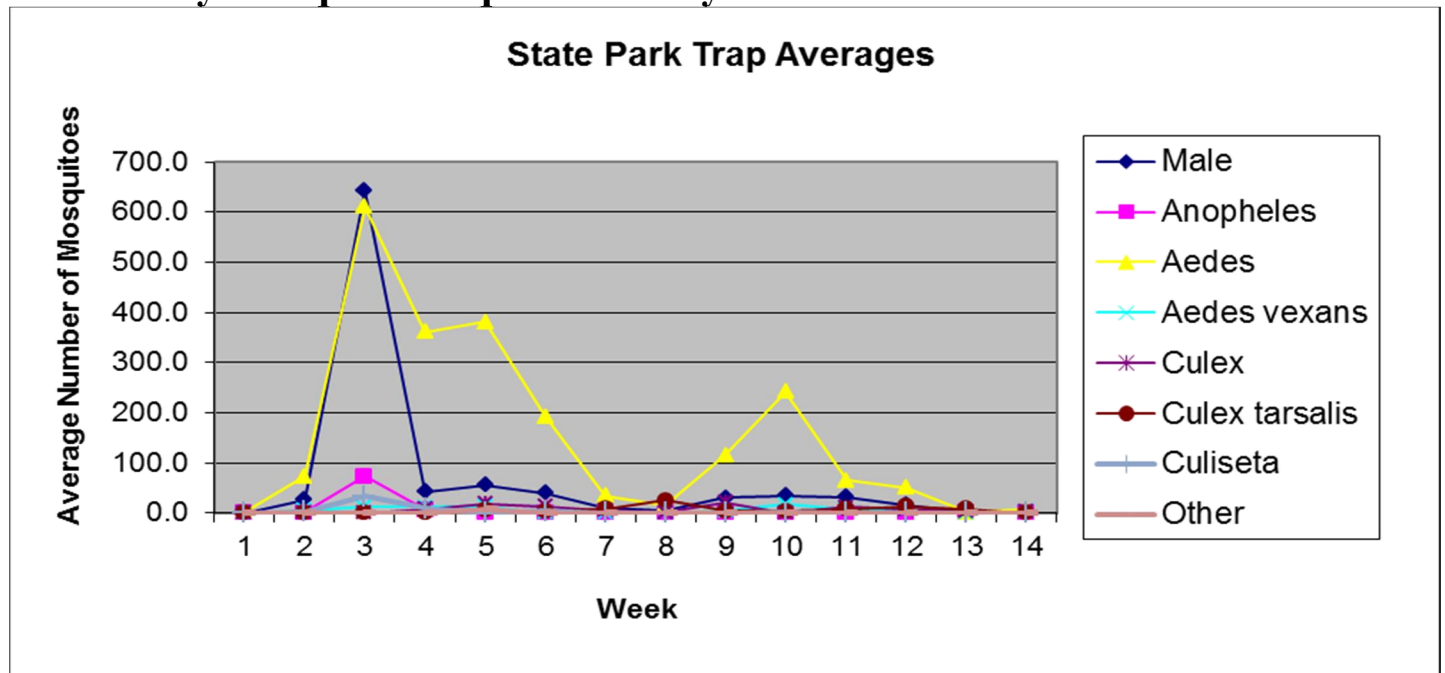
# **Region VIII** **North Dakota Mosquito Surveillance** **New Jersey Mosquito Trap Data Analysis**



# State Parks

## North Dakota Mosquito Surveillance

### New Jersey Mosquito Trap Data Analysis

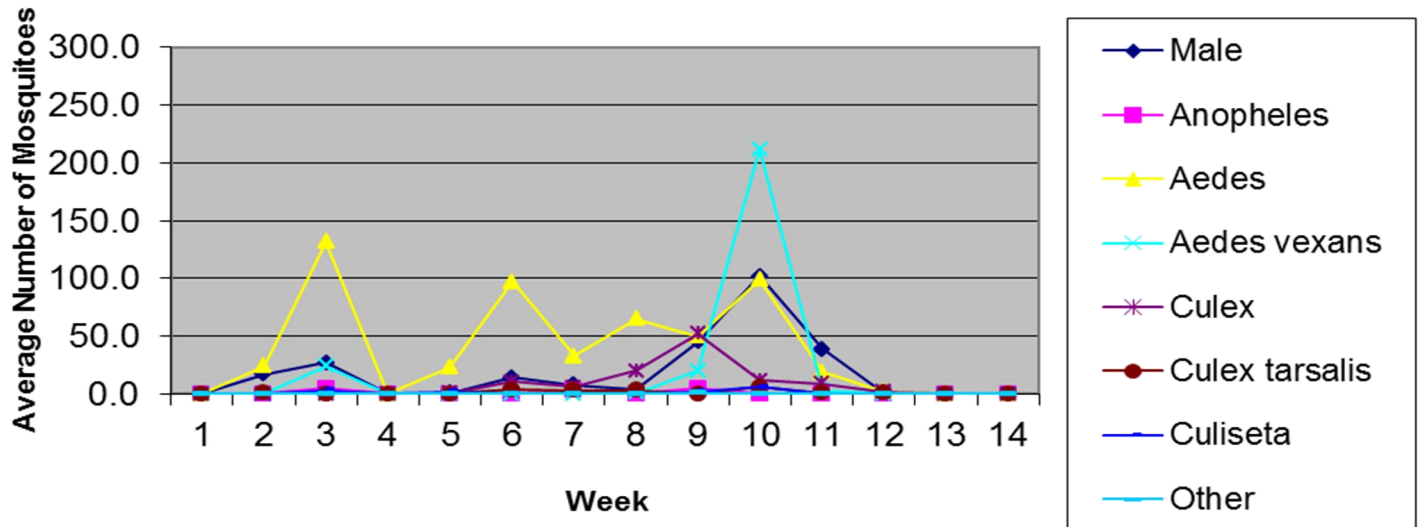


# National Wildlife Refuges

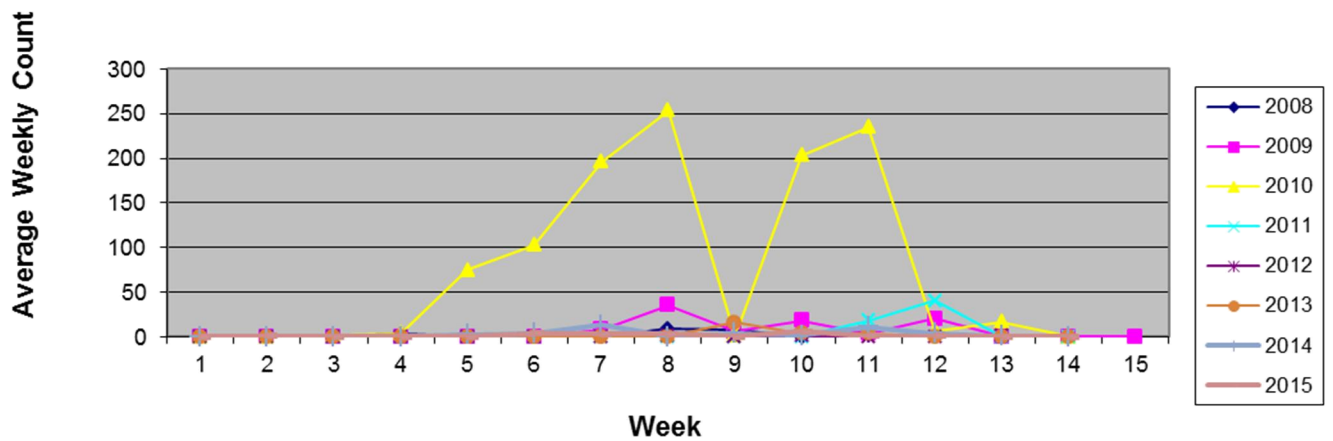
## North Dakota Mosquito Surveillance

### New Jersey Mosquito Trap Data Analysis

**National Wildlife Refuges Trap Averages**



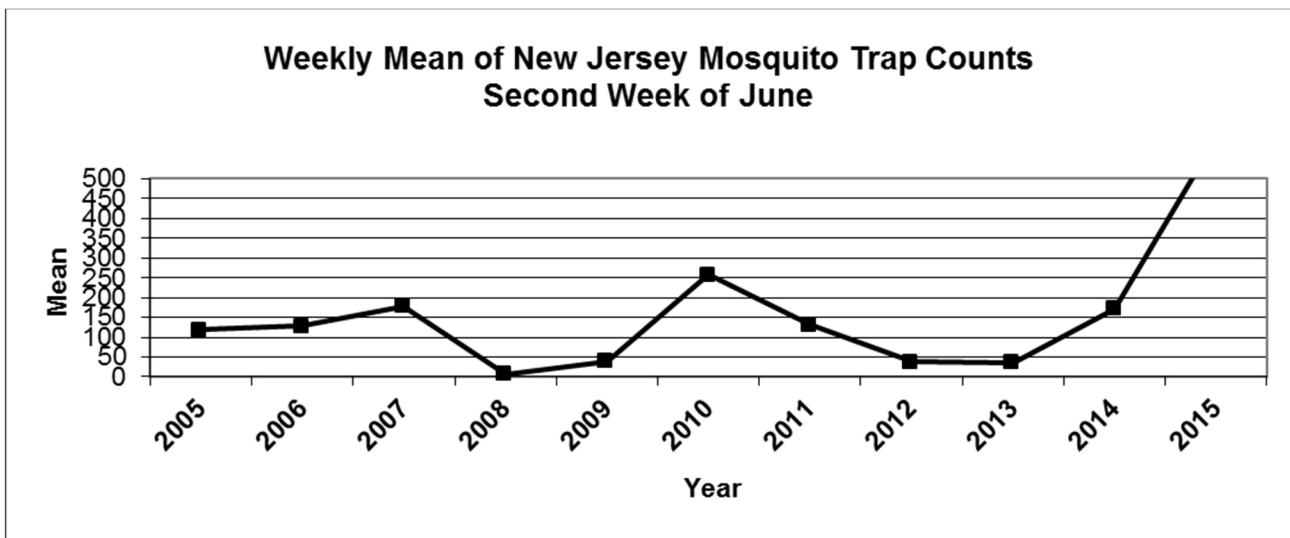
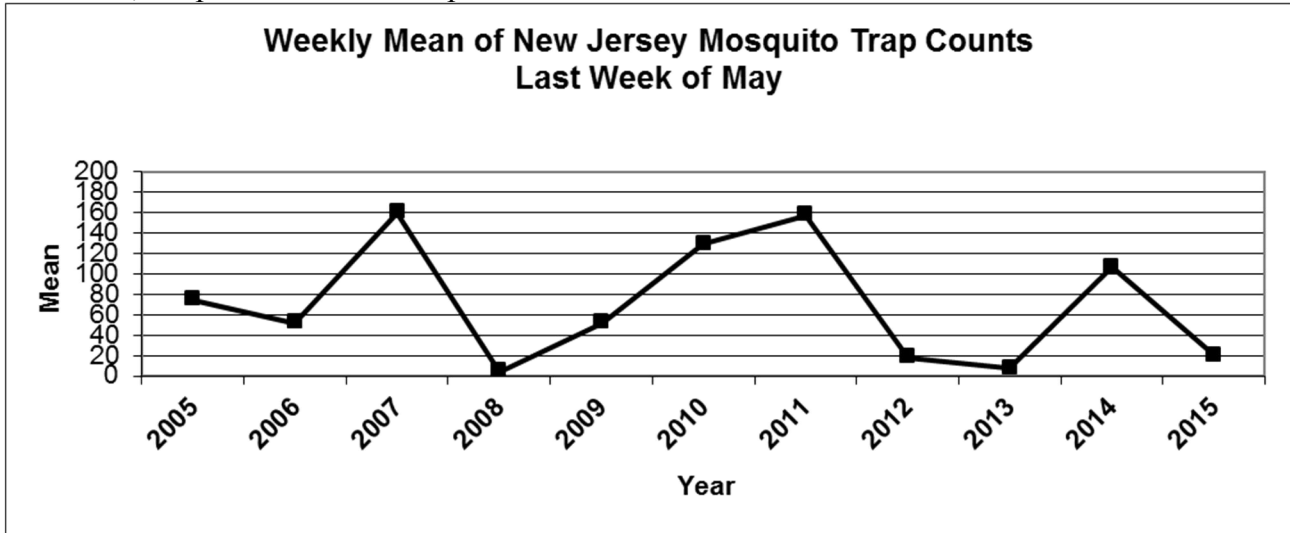
**NWR Average Weekly Counts of Female Culex tarsalis:  
2008-2015**



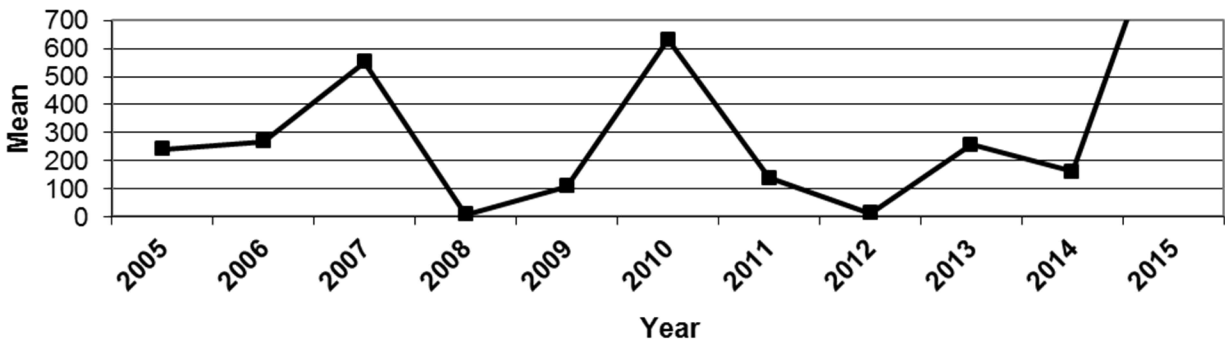
## Appendix B 2005-2015

### Weekly New Jersey Mosquito Trap Counts Comparison

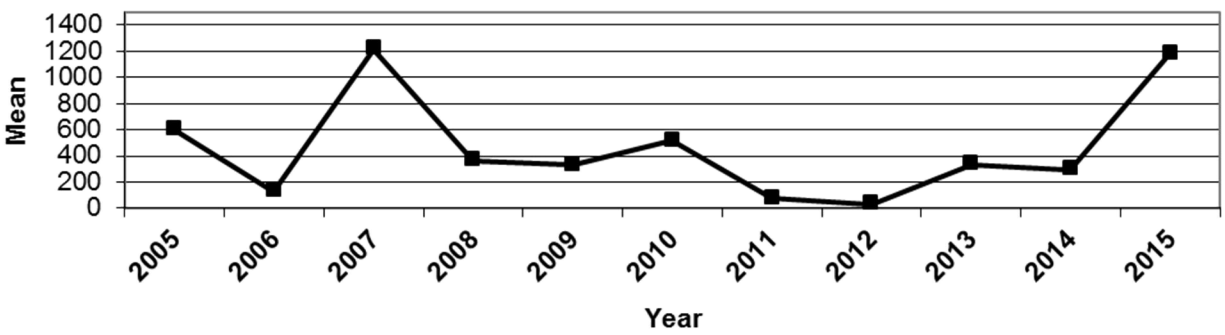
Appendix B includes graphs of the annual trap counts from the last week of May through the first week of September. These graphs depict how the mosquito trap counts have changed between 2005 and 2015. Each year, the general trend of North Dakota's mosquito population is a steady rise in population that peaks in early to late July, followed by a gradual decrease through the rest of the mosquito season. Yearly and weekly variances in trap numbers can be attributed to factors such as rainfall, temperature and wind speed.



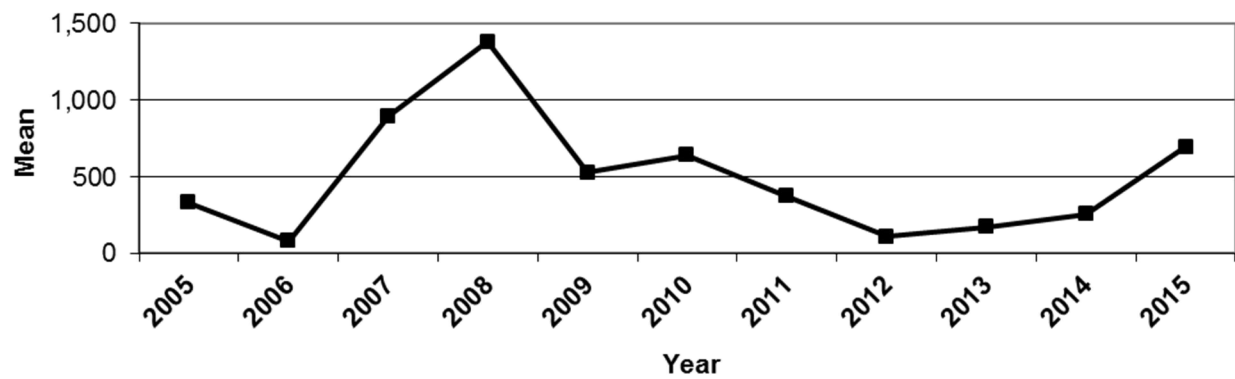
**Weekly Mean of New Jersey Mosquito Trap Counts  
Third Week of June**



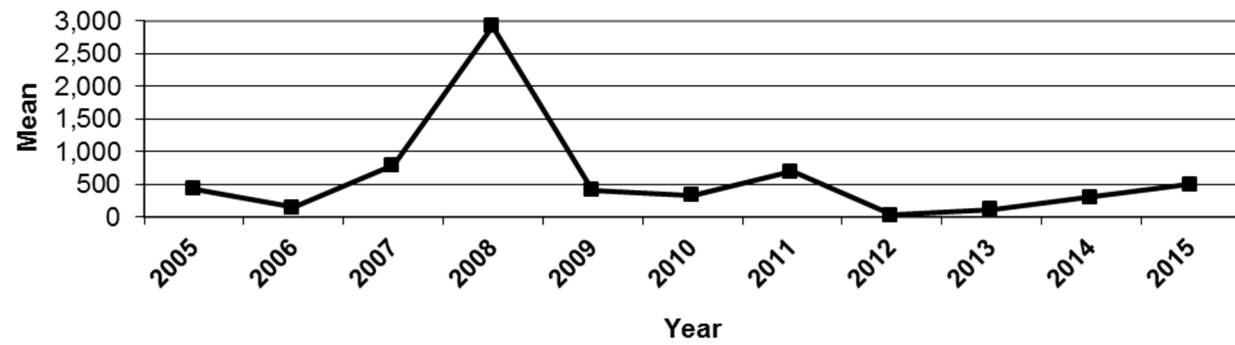
**Weekly Mean of New Jersey Mosquito Trap Counts  
Fourth Week of June**



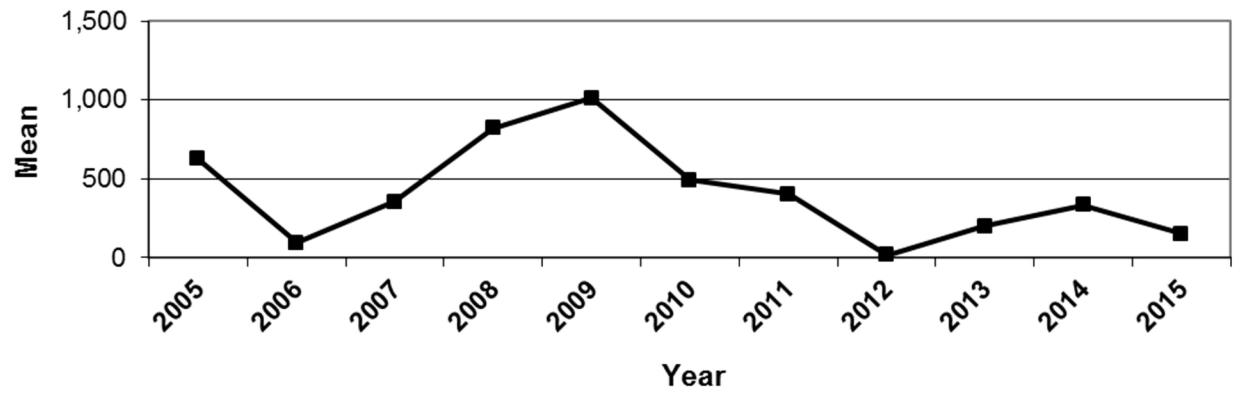
**Weekly Mean of New Jersey Mosquito Trap Counts  
Fifth Week of June - First Week of July**



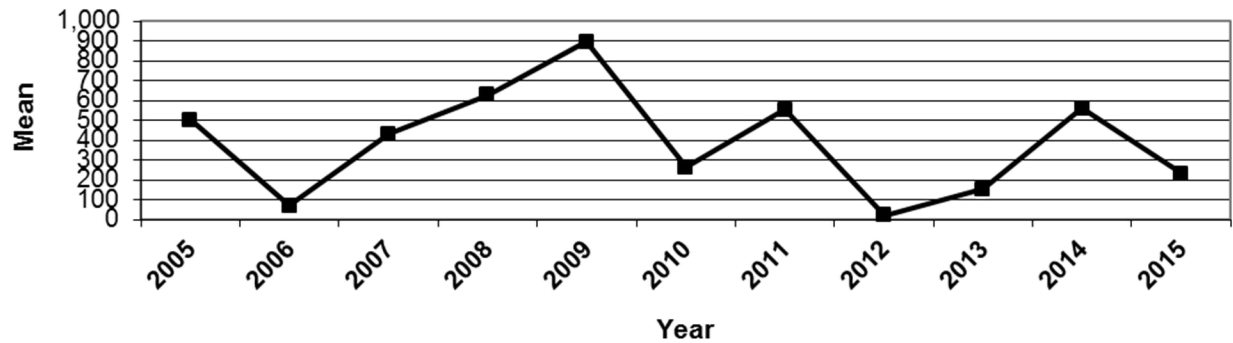
**Weekly Mean of New Jersey Mosquito Trap Counts  
Second Week of July**

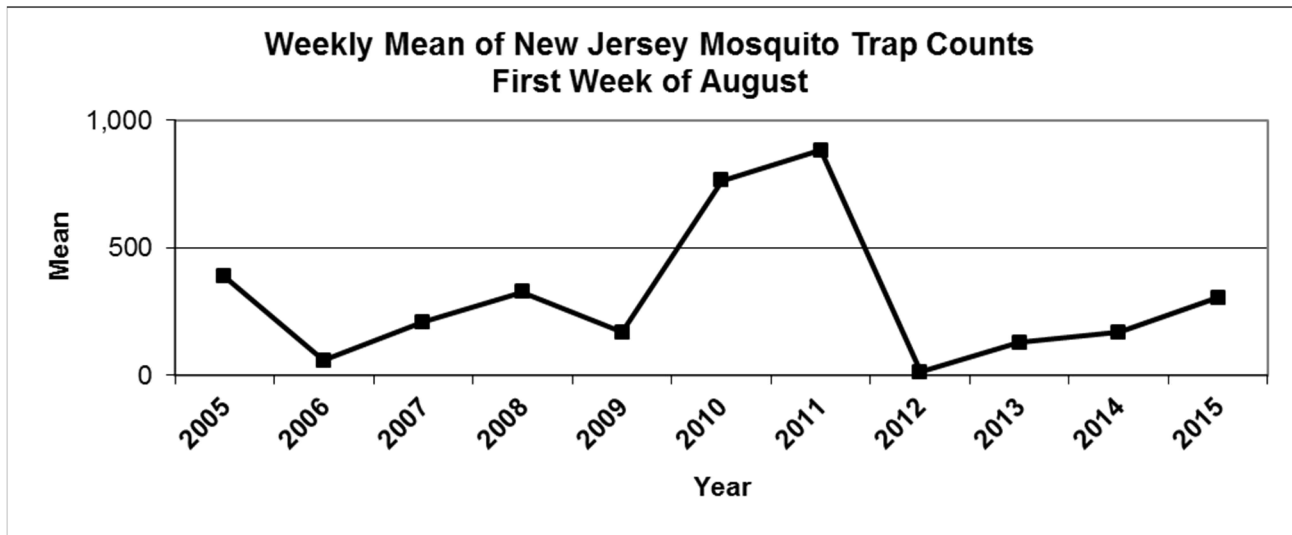
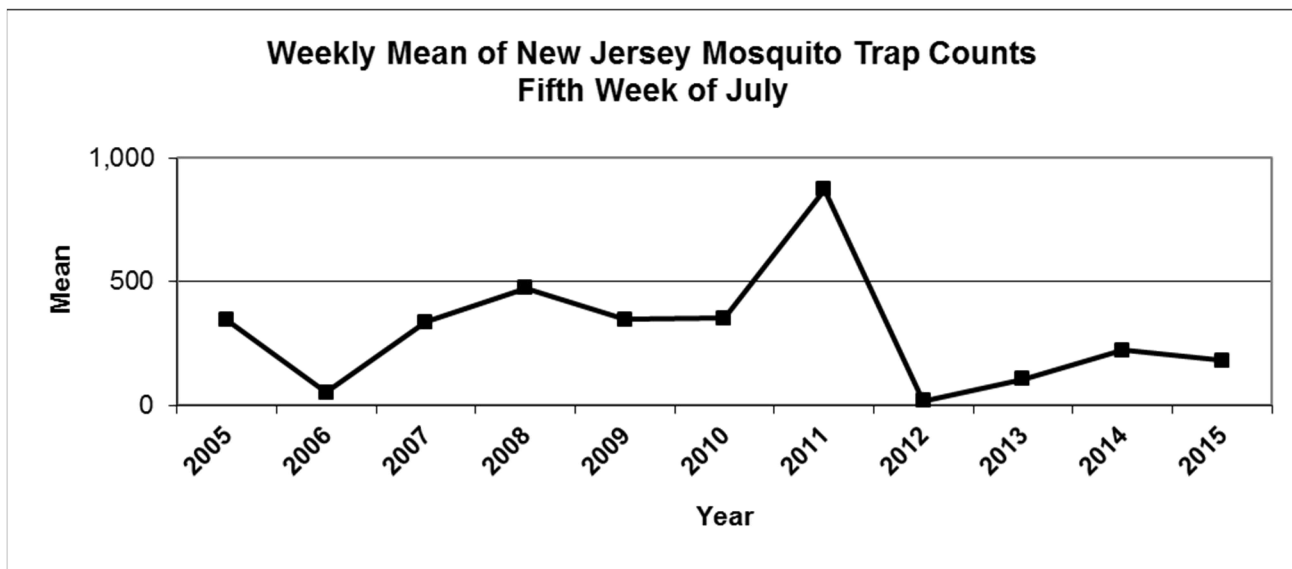


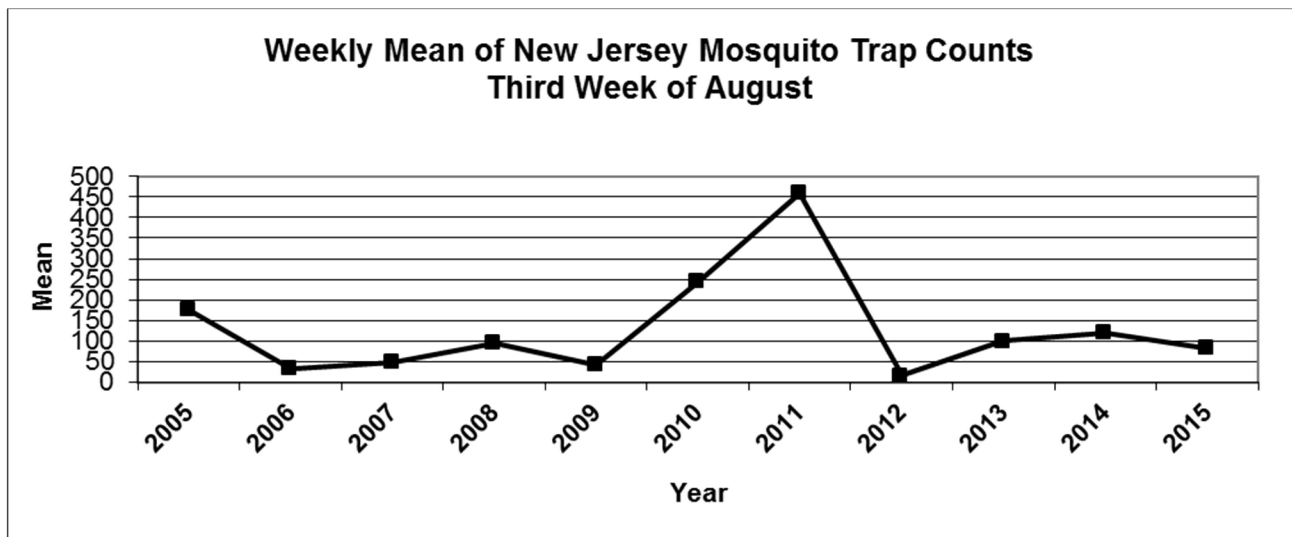
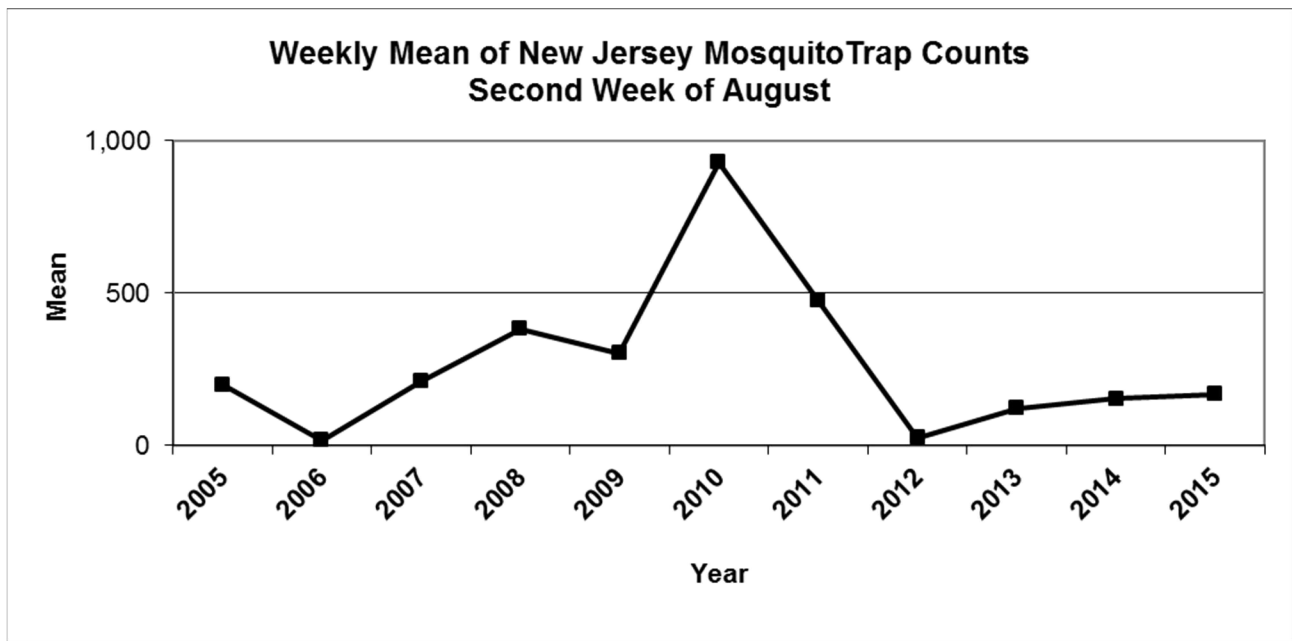
**Weekly Mean of New Jersey Mosquito Trap Counts  
Third Week of July**

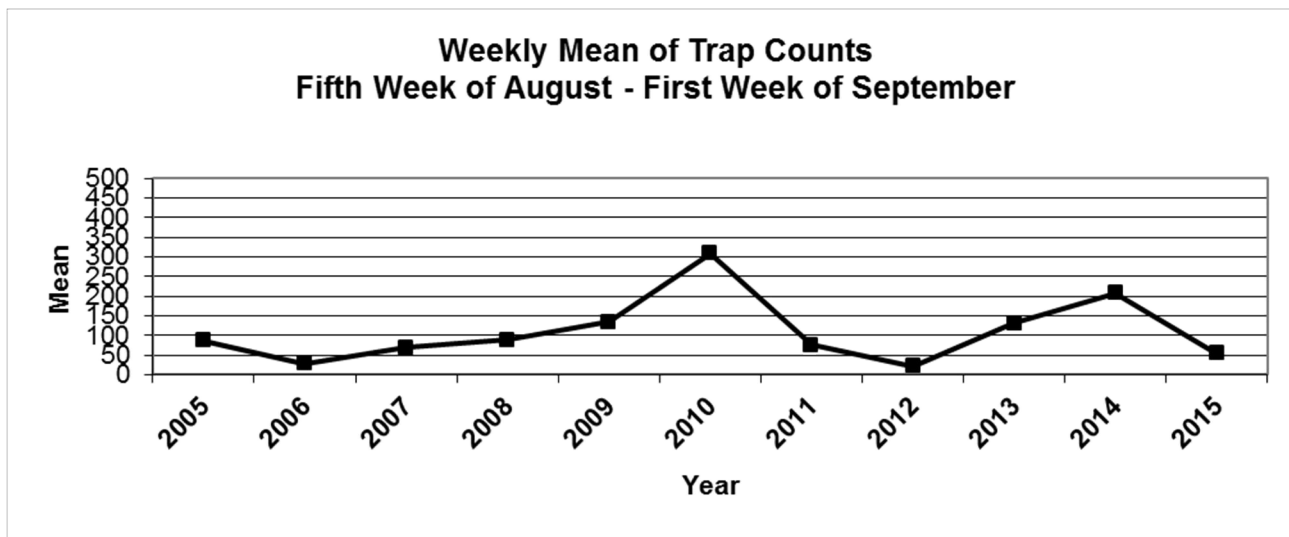
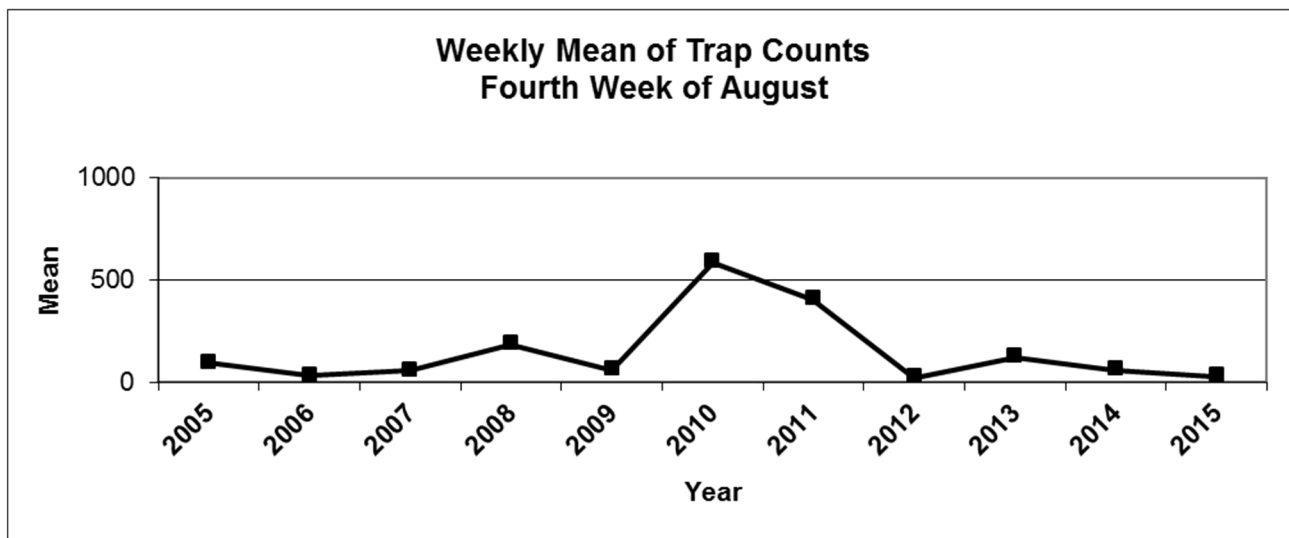


**Weekly Mean of New Jersey Mosquito Trap Counts  
Fourth Week of July**









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10. Henke, Michelle; Iverson, Sara; Auen, Cari. (2008). *2008 North Dakota Mosquito Surveillance Program Report*. Bismarck, North Dakota: North Dakota Department of Health, Division of Laboratory Services — Microbiology.

11. <http://www.ag.ndsu.edu/pubs/plantsci/pests/e472s.htm>
12. <http://www.cdc.gov/sle/technical/epi.html>
13. [http://diseasemaps.usgs.gov/sle\\_nd\\_human.html](http://diseasemaps.usgs.gov/sle_nd_human.html)